PLAN for
WATERSHED PROTECTION
FLOOD PREVENTION
and
RECREATION

WET WALNUT CREEK SUBWATERSHED NO. 3

NESS COUNTY, KANSAS

ADDENDUM

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

This addendum was developed in accordance with phase-in procedures adopted by the Water Resources Council for level C plans for which field studies, analyses, and evaluations were completed as of October 25, 1973, and which have been formulated in accordance with Senate Document 97, as supplemented and amended. This plan was developed using 1974 prices and a 6 1/8 percent discount rate.

Section I of this addendum shows the benefit-cost ratio with and without secondary benefits using the price base and discount rate used in the plan.

Section II of this addendum displays an abbreviated alternative plan for Wet Walnut Creek Basin as a whole and was developed to emphasize environmental quality. This is a hypothetical plan, not to be installed, which presents information for comparison with the selected plan.

Section III of this addendum displays the effects of the selected plan for Wet Walnut Creek as evaluated for each of the separate accounts--national economic development, environmental quality, regional development, and social well-being.

SECTION I

of

ADDENDUM

for

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

This section shows the project costs, benefits, and benefit-cost ratio based on 6 1/8 percent interest rate.

1.	Average annual project costs are	$297,400
2.	Average annual project benefits without secondary benefits are	$303,800
3.	Average annual project benefits with secondary benefits are	$390,100
4.	The project benefit-cost ratio without secondary benefits is	1.02 to 1.0
5.	The project benefit-cost ratio with secondary benefits is	1.31 to 1.0

December 1975

SECTION II

of

ADDENDUM

for

WET WALNUT CREEK WATERSHED, KANSAS

Abbreviated Environmental Quality Plan

This Environmental Quality Plan must consider the Wet Walnut Creek basin as a whole. This plan is not restricted by limitations of any existing authority such as PL-566. Elements to be installed in certain portions of the basin are interrelated to elements and effects in other portions of the basin therefore necessitating basin-wide planning.

Environmental Problems

A. Natural Beauty and Human Enjoyment Area Problems

Shade tree population and quality in small towns within the basin have deteriorated in recent years due to Dutch Elm disease and improper management.

Open spaces for public use within the basin are non-existent. Recreational facilities within reasonable distance from the area are limited.

B. Biological Resource Problems

The existence and needs of rare and endangered species within the basin is little known.

Educational facilities focusing on the environment and preservation of natural resources are lacking in the basin.

The lack of diversity in large tract farming practices has adversely affected wildlife species.

Many acres of Type 1 and 2 wetlands in the western part of the basin are not utilized to their fullest potential for enhancement of wildlife.

The lack of ground water management within the basin has adversely affected stream aquatic habitat and riparian habitat.

C. Archeological and Historical Sites Problems

Archeological, historical, and unique architectural sites are unrecorded or destroyed because of the lack of information and communication between the local public and interested authorities.

D. Land, Water and Air Quality Problems

Unprotected sloping cropland and rangeland within the basin are subject to moderate or severe sheet erosion. The mainstem of Wet Walnut Creek is subject to heavy sedimentation. The average sediment yield for the basin is 108 acre-feet/year.

E. Need for Minimizing Conflicts in Land Use

Increased competition for land and water resources within the area make it important that resource problems be anticipated and that people have the authorities to deal with them. Short and long range comprehensive planning is needed to identify, protect, and enhance important values.

Component Needs

A. Areas of Natural Beauty and Human Enjoyment

A small town shade tree restoration program

Creation of open space public-use areas

B. Biological Resources

Full utilization of certain wetlands within the watershed should be accomplished.

Improve ground water management.

Improvement of fish and wildlife habitat.

Preserve existing riparian habitat.

C. Historical and Archeological Sites

Preservation of historical sites.

Preservation or notation of archeological sites that may be involved with future development areas.

D. Land, Water and Air Quality

Establish proper management systems on lands within the watershed.

E. Conflicts in Land Use

Establish a comprehensive land use plan.

Environmental Quality Plan Elements

A. Management, protection, enhancement, and creation of areas of natural beauty and human enjoyment.

1. Establish a shade tree development program for 13 rural towns.

   Installation by: Towns

   Technical Assistance by: Department of State and Extension Forestry

   Cost: $25,000; $2,000 OM&R

2. Establish 700 farmstead windbreaks and 160 acres of shelterbelts.

   Installation by: Landowners, Department of State and Extension Forestry, Agricultural Stabilization and Conservation Service

   Technical Assistance by: Department of State and Extension Forestry

   Cost: Included in land treatment ($45,000)

3. Rehabilitate 30 farmstead windbreaks.

   Installation by: Landowners (cost sharing program needed)

   Technical Assistance by: Department of State and Extension Forestry

   Cost: Included in land treatment ($2,000)

4. Establish 4 open space public use areas by purchasing and developing 1,737 acres. Establish within these areas 4 separate developments including a total of 322 acres in resevoirs, 644 acres of public use area, and 771 acres in buffer zones.

   Installation by: Kansas Forestry, Fish and Game Commission, Bureau of Outdoor Recreation, State Park and Resources Authority

   Technical Assistance by: Same as above

   Cost: $1,996,600 $40,100 OM&R

B. Management, preservation, and enhancement of especially valuable or outstanding biological resources or ecosystems.

1. Survey the occurrence of endangered and threatened species and their habitat needs.

   Installation by: Kansas Forestry, Fish and Game Commission

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $9,000

2. Establish 3 outdoor classroom educational facilities encompassing a total of 60 acres.

   Installation by: School districts

   Technical Assistance by: Soil Conservation Service, Extension Forestry, Educational Institutions, Kansas Forestry, Fish and Game Commission, and Kansas Advisory Council on Environmental Education

   Cost: $18,000; $1,000 OM&R

3. Obtain easements on 3,150 acres of Type 1 and 2 wetlands in Subwatershed Nos. 4 and 5.

   Installation by: Kansas Forestry, Fish and Game Commission

   Technical Assistance by: Same as above

   Cost: $157,500

4. Increase land use diversity on 70,000 acres of cropland by using variable cropping patterns to provide increased edge effect and habitat diversity.

   Installation: Landowners

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $35,000; $1,800 OM&R

5. Establish an extensive ground water management program including regulated withdrawl and a system of 44 recharge structures and 4 multipurpose (recharge - public use) strucutres to improve 265 miles of stream aquatic habitat.

   Installation by: Watershed district, Kansas Water Resources Board, Kansas Forestry, Fish and Game Commission, (Ground Water Management District needed)

   Technical Assistance by: Kansas Water Resources Board, Kansas Forestry, Fish and Game Commission USGS, Soil Conservation Service

   Cost: (48 sites) $11,872,100; $42,000 OM&R

6. Obtain easements on 11,000 acres of existing riparian habitat.

   Installation by: Kansas Forestry, Fish and Game Commission, Landowners (Cost sharing program needed)

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $600,000

7. Protect 20 miles of existing stream aquatic habitat from sedimentation by removal of major obstructing log jams.

   Installation by: Landowners, Watershed district

   Technical Assistance by: Department of State and Extension Forestry, Kansas Forestry, Fish and Game Commission, Soil Conservation Service

   Cost: $15,000; $500 OM&R

C. Management, preservation, and enhancement of archeological and historical resources.

1. Survey construction and development sites to determine location, significance, and salvage requirements of archeological sites.

Installation by: National Park Service

Technical Assistance by: State Archeologist, National Park Service

Cost: $10,000

2. Identify and encourage preservation of unique architectural and historical sites.

Installation by: State and local historical societies

Technical Assistance by: State Historical Society

Cost: (not determined)

D. Quality considerations of water, land, and air resources.

1. Install land treatment measures and establish proper management systems to accomplish 100 percent watershed protection. Remaining needs include treatment of 257,000 acres of cropland, 124,500 acres of rangeland, 1700 acres of woodland, and 5000 acres other land.

Installation by: Landowners, Agricultural Conservation Program

Technical Assistance by: Soil Conservation Service, Department of State and Extension Forestry

Cost: $5,773,900; $863,000 OM&R

E. Avoid irreversible and irretrievable commitments of resources.

1. Establish a comprehensive plan including land and water use for each county within the basin.

Installation by: Cities and counties

Technical Assistance by: KDED

Cost: $60,000

Effects of Environmental Quality Plan

A. Areas of Natural Beauty and Human Enjoyment

The beauty of small towns within the watershed will be enhanced due to a shade tree restoration program. Rural area beauty and aesthetics will be improved through application of land treatment practices and windbreak and shelterbelt restoration or establishment. Flood plain area natural beauty will be maintained through preservation of the riparian habitat.

The creation of four public use areas will provide needed facilities for water-based recreation. The public developments will provide facilities for 53,100 sightseers, 19,200 picnickers, 41,900 fishermen, 1,800 boaters, and 14,000 campers, totalling 130,000 recreation days annually. Acquisition of areas associated with the developments will provide 966 acres for dams, reservoirs, and facilities and 771 acres of open space for public use. Creation of the developments will cause disruption in the tranquility of the rural environment by 130,000 recreation days annually.

B. Biological Resources

Terrestrial wildlife habitat in 40 acres of windbreaks will be improved due to rehabilitation. An additional 860 acres will be created through establishment of new windbreaks and shelterbelts.

Conservation land treatment on 388,200 acres of agriculture land and land use diversity on 70,000 acres of cropland will improve terrestrial wildlife habitat.

The existence and habitat needs of endangered and threatened species within the watershed will be identified.

The creation of 48 reservoirs will inundate 2,030 acres of terrestrial wildlife habitat and 51, 9, and 7 miles of ephemeral, intermittent, and perennial stream aquatic habitat respectively. The structures will create 2,030 acres of impounded aquatic habitat. Maintenance of flow will improve 142 and 123 miles of intermittent and perennial stream aquatic habitat respectively. Associated riparian habitat will also be improved.

Eleven thousand acres of riparian habitat and 3150 acres of Type 1 and 2 wetlands will be preserved.

The environmental education of young people within the area will be enhanced through use of outdoor classrooms.

C. Historical and Archeological Sites

Significant historical and archeological sites within the watershed would be identified.

D. Land, Water, and Air Quality

The application of land conserving practices on 257,000 acres of cropland, 124,500 acres of rangeland, 1,700 acres of woodland, and 5,000 acres of other land would bring 100 percent of the watershed under conservation treatment. Land treatment measures will reduce sediment yield from 108 acre feet per year to 78 acre feet per year. Land treatment plus 48 reservoirs will reduce sediment yield to 52 acre feet per year.

E. Irreversible and Irretrievable Commitments

Reservoirs will convert 1,419 acres of cropland; 2,766 acres of rangeland; and 51, 9, and 7 miles of ephermeral, intermittent, and perennial stream aquatic habitat respectively to reservoir pools, dams, spillways, and public use areas.

F. Conflicts in Land Use

Implemented land and water use planning for the watershed area will provide the authority to deal with conflicts in the use of the resources. Important environmental values will be recognized and protected through implementation of the plan.

SECTION III

of

ADDENDUM

for

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

Display of Selected Plan

in

National Economic Development Account

Regional Development Account

Social Well-Being Account

Environmental Quality Account

SELECTED PLAN

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

Components	Measure of Effects (average annual dollars)	Components	Measure of Effects (average annual dollars)
Beneficial effects		Adverse effects	
A. The value to users of increased outputs of goods and services		A. The value of resources required for a plan	
1. Flood damage reduction	217,600	1. Multipurpose reservoir and 11 single-purpose flood prevention reservoirs	
2. More intensive use	26,200	Project Installation[a/]	211,000
3. Recreation	60,000	Project Administration[a/]	67,400
		OM&R	19,000
		Total Adverse Effects	297,400
Total Beneficial Effects	303,800	Net Beneficial Effects	6,400

a/ Amortized for 100 years at 6 1/8 percent interest

December 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

Components	Measure of Effects (average annual dollars)	
	Region	Rest of Nation
A. Income		
Beneficial effects		
1. The value of increased output of goods and services to users residing in the region		
a. Flood damage reduction	217,600	
b. More intensive use	26,200	
c. Recreation	30,000	30,000
d. Secondary	86,300	
Total Beneficial Effects	360,100	30,000

Components	Measure of Effects (average annual dollars)	
	Region	Rest of Nation
A. Income		
Adverse effects		
1. The value of resources contributed from within the region to achieve the output		
a. Multipurpose reservoir and 11 single-purpose flood prevention reservoirs		
Project Installation[a/]	28,300	182,700
Project Administration[a/]	5,800	61,600
OM&R	9,100	9,900
Total Adverse Effects	43,200	254,200
Net Beneficial Effects	316,900	

a/ Amortized for 100 years at 6 1/8 percent interest

December 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

Components	Measure of Effects	
	Region	Rest of Nation
B. Employment		
Beneficial effects		
1. Increase in the number and type of jobs		
a. Employment for project construction	68 man years semiskilled	
	23 man years unskilled	
b. Employment for project OM&R	1.6 man years unskilled annually	
Total Beneficial Effects	1.6 permanent unskilled jobs	
	68 semiskilled jobs for 1 year	
	23 unskilled jobs for 1 year	

Components	Measure of Effects	
	Region	Rest of Nation
B. Employment		
Adverse effects		
1. Decrease in the number and type of jobs		
Total Adverse Effects	0	
Net Beneficial Effects	1.6 permanent unskilled jobs	
	68 semiskilled jobs for 1 year	
	23 unskilled jobs for 1 year	

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

Components	Measure of Effects	
	Region	Rest of Nation
C. Population Distribution		
Beneficial effects	Creates 68 semiskilled jobs for 1 year	
	Creates 23 unskilled jobs for 1 year	
	Creates 1.6 man years permanent employment annually	-
Adverse effects	-	-
D. Regional Economic Base and Stability		
Beneficial effects	Provides floodwater damage reduction for 52,561 acres	
	Creates 1.6 man years of unskilled employment annually	
	Creates 68 short-term semiskilled and 23 short-term unskilled jobs	

SELECTED PLAN

SOCIAL WELL-BEING ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 3, Kansas

Components	Measure of Effects
Beneficial and adverse effects	
A. Real income distribution	1. Create 91 man years low to medium income jobs for area residents during construction.
	2. Create 1.6 man years low to medium income employment annually in association with operation and maintenance of the works of improvement.
	3. Create regional income benefit distribution of $360,100. Family incomes are distributed: Under $3,000 — 20% $3,000 to $10,000 — 57% Over $10,000 — 23% It is assumed that benefits will be distributed at about the same percentages.
	4. Local costs to be borne by the watershed region total $43,200. Costs to be distributed by about the same ratio as benefits.
B. Life, health, and safety	1. Provide a sense of economic security and the psychological security associated with the abatement of a fear of flooding.
C. Recreation opportunities	1. Create 30,000 recreational visits. Forty-five percent of these will be utilized by residents from outside the region.

September 1975

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

Components	Measure of Effects
Beneficial and adverse effects	
A. Open and green space, lakes, and other areas of natural beauty	1. Create lake with 40 surface acres for water-based recreation open to the public.
	2. Create 11 floodwater retarding structures and 9 detention dams with a total of 740 surface acres on private land.
	3. Create 200 acres for multipurpose use including public recreation and open and green space.
	4. Improve rural area beauty on 82,380 acres of agricultural land by the application of land treatment practices.
	5. Increase traffic, litter, and noise in a sparsely populated rural community from 30,000 visitor days annually.
	6. Twenty-one reservoir structures will increase landscape diversity.

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 3, KANSAS

Components	Measure of Effects
Beneficial and adverse effects	
D. Irreversible or irretrievable commitments	1. Commit 185 acres cropland and 595 acres rangeland to sediment and recreation pools.
	2. Commit 338 acres cropland and 205 acres rangeland to dams and spillways.
	3. Commit 144 acres rangeland to recreational land.
	4. Inundate 8 miles of ephemeral stream.
	5. Change 10 miles of ephemeral to intermittent stream through increased base flows.

WATERSHED PLAN AGREEMENT

between the

WET WALNUT CREEK WATERSHED JOINT DISTRICT NO. 58
Local Organization

NESS COUNTY CONSERVATION DISTRICT
Local Organization

KANSAS FORESTRY, FISH AND GAME COMMISSION
Local Organization

(hereinafter referred to as the
Sponsoring Local Organizations)

STATE OF KANSAS

and the

Soil Conservation Service
United States Department of Agriculture

(hereafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Wet Walnut Creek Subwatershed No. 3, State of Kansas, under the authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Wet Walnut Creek Subwatershed No. 3, State of Kansas, hereinafter referred to as the watershed plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of

Agriculture, through the Service, hereby agree on the watershed plan, and further agree that the works of improvement as set forth in said plan can be installed in about 10 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed plan:

1. The Sponsoring Local Organizations will acquire such land rights as will be needed in connection with the works of improvement. The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Land Rights Cost (dollars)
Multipurpose Str. No. 34 and Recreational Facilities			
Payment to landowners for about 200 acres	50	50	40,000
Legal fees, survey costs, flowage easements, and other	100	0	4,200
11 Floodwater Retarding Structures	100	0	391,000

The Sponsoring Local Organizations agree that all land acquired or improved with P.L. 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The Sponsoring Local Organizations assure that comparable replacement dwellings will be available for individuals and persons displaced from dwellings,

and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organizations and the Service as follows:

	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	37.8	62.2	11,000

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Construction Costs (dollars)
11 Floodwater Retarding Structures	0	100	2,397,500
Multipurpose Structure No. 34	11.9	88.1	191,900
Recreational Facilities	50[a/]	50[b/]	32,600

a/ The Sponsoring Local Organizations will provide the equipment and labor necessary for installation of the recreational facilities.

b/ The Service will provide materials necessary for installation of the recreational facilities.

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Engineering Costs (dollars)
11 Floodwater Retarding Structures	0	100	336,500
Multipurpose Structure No. 34	0	100	27,500
Recreational Facilities			
Layout and design	100	0	2,400
On-site planning and standard designs	0	100	800

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be $94,400 and $1,003,800 respectively.

7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed plan.

9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed. Detention dams will be operated and maintained by landowners at their own expense through agreements with the watershed district.

10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work

or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed plan is contingent on the availability of appropriations for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working agreements and other conditions that are applicable to the specific works of improvement.

13. The watershed plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organizations have failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organizations in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organizations or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties. An amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsor(s) having specific responsibilities for the particular structural measure involved.

14. No member of or delegate to congress, or resident commissioner, shall be admitted to any share or part

of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1 - 15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefit of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

WET WALNUT CREEK WATERSHED
JOINT DISTRICT NO. 58
Local Organization

By s/Lloyd E. West

Title President

Box 207, LaCrosse, Ks. 67548
Address Zip Code

Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the
WET WALNUT CREEK WATERSHED JOINT DISTRICT NO. 58
Local Organization

adopted at a meeting held on March 18, 1976

s/Lawrance Richards
Secretary, Local Organization

Box 207, LaCrosse, Ks. 67548
Address Zip Code

Date May 13, 1976

NESS COUNTY CONSERVATION
DISTRICT
Local Organization

By s/Keith E. Rider

Title Chairman

Box 439, Ness City, Ks. 67560
Address Zip Code

Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the NESS COUNTY CONSERVATION DISTRICT
Local Organization

adopted at a meeting held on May 4, 1976

s/Kay Wasinger
Secretary, Local Organization

Box 439, Ness City, Ks. 67560
Address Zip Code

Date May 13, 1976

KANSAS FORESTRY, FISH AND GAME COMMISSION
Local Organization

By s/Richard D. Wettersten

Title Director

Box 1028, Pratt, Ks. 67124
Address Zip Code

Date May 1976

The signing of this agreement was authorized by a resolution of the governing body of the
KANSAS FORESTRY, FISH AND GAME COMMISSION
Local Organization

adopted at a meeting held on May 1976

s/Jerome Salyer
Secretary, Local Organization

Box 1028, Pratt, Ks. 67124
Address Zip Code

Date May 1976

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

s/Robert K. Griffin
State Conservationist

May 13, 1976
Date

WATERSHED PLAN

Wet Walnut Creek Subwatershed No. 3

Ness County, Kansas

Prepared Under the Authority of the
Watershed Protection and Flood Prevention Act
(Public Law 566, 83d Congress; 68 Stat. 666) as amended

Prepared by

Ness County Conservation District
Wet Walnut Creek Watershed Joint District No. 58
Kansas Forestry, Fish and Game Commission

With Assistance by

U.S. Department of Agriculture

Soil Conservation Service
Forest Service

State of Kansas

Conservation Commission
Water Resources Board
Department of State and Extension Forestry

April 1976

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Watershed Plan
Wet Walnut Creek Subwatershed No. 3
Ness County, Kansas
December 1975

SUMMARY OF PLAN

Subwatershed No. 3 covers 357 square miles in west-central Kansas in Ness County. It is one of five watersheds which were planned jointly. It is sponsored by the Wet Walnut Creek Watershed Joint District No. 58, Ness County Conservation District, and the Kansas Forestry, Fish and Game Commission.

The major problems in the watershed are flood damage along the mainstem of Wet Walnut and North Fork Wet Walnut Creeks. Other problems are erosion, sedimentation, potential ground water decline, and a shortage of water-based public recreational areas. Average annual direct floodwater damages in the watershed are estimated at $9,000 of which 78 percent is crop and pasture damage.

The proposed watershed project will consist of land treatment and structural measures. Adequate land treatment will be accomplished on 52,000 acres of cropland, 30,000 acres of rangeland, and 380 acres of forestland. Land treatment measures include nine detention dams. Eleven floodwater retarding structures and one multipurpose structure for floodwater retardation and public recreation will be constructed. The Kansas Forestry, Fish and Game Commission will develop the recreational facilities of the multipurpose reservoir.

Average annual flood damage will be reduced 36 percent. The average annual soil loss in the watershed will be reduced from 3.7 to 2.6 tons per acre. Average annual sediment yield from this watershed to Wet Walnut Creek will be reduced by 32,000 tons. Average annual recharge will be increased 5,000 acre feet.

The major impact on water quality in Wet Walnut Creek will be the reduction of sediment load. Other impacts of the watershed project on the quality of streamflow will be minimal and localized. Increased base flows, decreased sediment concentration, and reduced erosion will increase fish habitat and food and water for all wildlife in the watershed. Aquatic habitat will, as a general rule, be improved with impoundment

and management of water in the sediment pools and multipurpose pools. Initially there will be loss of terrestrial wildlife habitat. Impoundments will increase both the fishery potential and the amount of suitable habitat for migratory waterfowl. Land treatment measures will increase wildlife cover and habitat diversity. The multipurpose structure will increase public recreation opportunities. In addition, the impounded areas will increase landscape diversity.

A ten-year period will be required for project installation. Installation costs will be $6,544,600 of which $4,067,600 will be P.L. 566 funds.

Land treatment measures will be maintained by individual landowners and operators through agreement with the conservation district. Wet Walnut Creek Watershed Joint District No. 58 will be responsible for the operation and maintenance of all floodwater retarding structures and the structural maintenance of the dam and spillway of the multipurpose structure. The Kansas Forestry, Fish and Game Commission will be responsible for operation and maintenance of the reservoir area and recreational facilities area at the multipurpose structure. The estimated average annual costs of operation and maintenance of structural measures are $19,000. Average annual benefits attributable to structural measures are expected to be $390,100; average annual costs for the measures are estimated at $297,400. Average annual flood damage reduction benefits from land treatment measures are estimated at $1,500.

WATERSHED RESOURCES--ENVIRONMENTAL SETTING

Physical Data

Subwatershed No. 3 of Wet Walnut Creek Watershed Joint District No. 58 is in Ness County in west-central Kansas. It covers an area of 357 square miles.[1]/ * Cities in the area are Ness City, Ransom, and Utica. The watershed population in 1970 was 3,057 of which 2,469 lived in cities.[2]/

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* See list of references

The watershed is in the Arkansas-White-Red Water resources region and the Arkansas River in Kansas subregion.[3/] It is along the northern border of these regions. The watershed experiences periods of too little or too much water which typifies these regions.

The major problem in the watershed is flood damage along the Wet Walnut Creek and the North Fork of Wet Walnut Creek. Urban flood damages in the watershed are limited to those storms in excess of a 100-year frequency. Sheet erosion in the upland drainage areas and scour in the flood plains are problems. Ponds, reservoirs, and stream channels are additional problem areas due to sedimentation. Ground water recharge is insufficient to meet the demand for increased irrigation in some areas. Rapid expansion of irrigation has occurred on the flood plain, but limited aquifer capacity will restrict future expansion. Recreational opportunities related to water are limited.

Soils on uplands in the watershed are predominantly of the Harney and Uly series. Much less extensive are soils classified as Coly, Heizer, and Wakeen series. Harney soils are formed in calcareous loess on nearly level and gentle slopes. They are deep, well-drained soils with silt loam surface layers over silty clay loam subsoils of moderately slow permeability. Uly soils are formed in calcareous loess on gentle to moderate slopes. They are deep, well-drained soils with silt loam surface layers over moderately permeable silt loam subsoils. Most of the Harney and Uly soils are cultivated and are productive of the crops adopted to the area. The minor Coly, Heizer, and Wakeen soils are on the steeper and sometimes broken slopes adjacent to drainageways and on narrow divides where geologic erosion has removed most of the mantle sediments. Coly soils are deep, well-drained, moderately permeable, and have formed in calcareous loess. The loamy Heizer soils are shallow over chalky limestone. The calcareous, well-drained Wakeen soils are moderately deep over chakly shale. These soils are not well suited for use as cropland. Most areas remain in native grass and are used for range.

Soils formed in alluvial sediments in the stream valleys are mostly of the Roxbury, Bridgeport, and Hord series. Roxbury and Bridgeport soils are on the lower flood plains and Hord

soils are on the less frequently flooded terraces. The deep, well-drained to moderately well-drained Roxbury soils are calcareous silt loam or silty clay loam throughout. Bridgeport soils have much thinner dark colored surface layers than Roxbury soils. They are deep, well-drained, calcareous soils with silt loam textures throughout. The deep, well-drained Hord soils are calcareous below depths of about 24 inches. They have silty clay loam textures throughout. These soils are well suited for use as cropland and most are cultivated.

The detailed soil survey of Ness County is complete but not published. The field sheets, map legend, and interpretative information are on file in the Soil Conservation Service field office in Ness City.

Soil forming materials vary markedly within short distances. Mortar beds and Caliche (Ogallala Formation) form the cap-rock rim at the breaks from the High Plains. The bedrock consists primarily of a yellowish, highly limy, chalky rock (Niobrara Chalk).

Most of the watershed surface materials are clay, silt, sand, and gravel of Pleistocene Age. The Pleistocene materials are separable into fluvial deposits on divides and in stream valleys, thick eolian silt or loess mantles on upland surfaces, and slope or alluvial and colluvial deposits in headlands areas of streams and on slopes along stream courses.

Erosional remains of the Ogallala Formation, a composite of fluvial deposits of Pliocene Age, cap the northern watershed divide. The Ogallala Formation unconformably overlies the following Cretaceous formations listed in descending order of age: Niobrara Chalk, Carlile Shale, and Greenhorn Limestone. The Carlile Shale is the predominant upland bedrock. Most of the bedrock in the watershed is covered by soils.

The eastern two-thirds of the watershed lies within the natural land resource area known as the Blue Hills section of the Dissected High Plains physiographic province.[4/] The western one-third of this watershed lies within the natural land resource area known as the High Plains section of the Great Plains physiographic province. The altitude of land surface ranges from 2,345 feet above mean sea level in the

northwest corner to 2,125 feet at the watershed outlet. Maximum relief is 220 feet, but local relief seldom exceeds 100 feet.

The watershed drains into North Fork Wet Walnut Creek and Wet Walnut Creek. North Fork Wet Walnut and Wet Walnut Creeks head in western Lane and eastern Scott Counties, about 30 miles west of the western boundary of the watershed. The Wet Walnut Creek valley ranges from 0.5 to 1.5 miles in width. The valley of North Fork Wet Walnut Creek ranges from 0.2 to 1.0 mile in width. The mainstem of Wet Walnut Creek is formed south of Ness City, Kansas, at the confluence of the South and North Forks of the creek. The stream continues eastward through Subwatershed Nos. 1 and 2, is joined by Dry Walnut Creek, and empties into the Arkansas River four miles east of Great Bend. All of the tributaries to Wet Walnut and North Fork Wet Walnut Creeks are ephemeral, except the intermittent lower three miles of Bazine Creek. Ephemeral streams flow only during periods of general runoff. Bazine Creek drains about the northeastern one-fourth of the watershed. This tributary empties into Wet Walnut at Bazine. Long Branch Creek drains the center of the watershed and empties into North Fork Wet Walnut Creek just above its confluence with South Fork Wet Walnut Creek east of Ness City. Wet Walnut and North Fork Wet Walnut Creeks have unmodified, well-defined natural channels. Wet Walnut and North Fork Wet Walnut Creeks are intermittent streams. They have periods of continuous flow but little or no flow during other times.

Normal annual precipitation is 20.24 inches at Ness City. The maximum in 1951 was 32.40 inches and the least was 10.06 inches in 1966. More than 70 percent of the annual precipitation is received during the growing season which averages 170 days between April and September. High intensity thunder storms usually occur during spring and summer months and often result in damaging floods. Normal annual temperature is 53 degrees. The recorded range is from 110 to -24 degrees.[5/]

The primary source of ground water is the alluvium in North Fork Wet Walnut and Wet Walnut Creek valleys. The amount of water is nearly proportional to the thickness of alluvium and size of drainage basin. Rain and snow-melt are principal recharge sources. The volume of water, as of 1973, estimated to be available for pumpage was 65,000 acre feet.

Mineral resources of the watershed include oil and gas, helium, sand and gravel, and limestone in addition to ground water.

Land use in the watershed is as follows: cropland, 150,493 acres (65.9 percent); rangeland, 72,023 acres (31.5 percent); forestland, 4,000 acres (1.7 percent); and miscellaneous, 2,052 acres (0.9 percent).

In the evaluated flood plain, 53 percent of the 1,194 acres of cropland is irrigated. There are also 148 acres of rangeland, 225 acres of forestland, and 27 acres miscellaneous in the flood plain.

Of the 149,299 acres of upland cropland, only 2,067 acres are irrigated. These are also 71,875 acres of rangeland, 3,775 acres of forestland, and 2,025 acres miscellaneous upland.

In its original or virgin condition the major portion of the watershed was natural prairie. This original vegetative community consisted primarily of big bluestem, little bluestem, blue grama, western wheatgrass, buffalograss, and sideoats grama on the uplands. In prairie drainways and bottomland areas, the original vegetation was primarily big bluestem, indiangrass, switchgrass, and western wheatgrass.

Following settlement much of the native rangeland was plowed and converted to cropland. Many small pastures were fenced and grazed by livestock including draft animals. Pastures were often heavily grazed yearlong, which altered the vegetative composition. On many pastures the taller grasses were largely replaced by less palatible plants or low growing vegetation which tended to tolerate heavy grazing.

Principal grasses on the uplands are blue grama, sideoats grama, buffalograss, western wheatgrass, tall dropseed, sand dropseed, annual brome, red threeawn, windmillgrass, silver bluestem, big bluestem, little bluestem, and switchgrass. Forbs and legumes include Louisiana sagewort, western ragweed, heathaster, falseboneset, dotted gayfeather, Missouri goldenrod, prairie coneflower, black sampson, resinous skullcap, wavyleaf thistle, blue windindigo, and slimflower scurfpea. Woody plants consist primarily of smooth sumac, skunkbrush, plum, and buckbrush.

Major grasses on the lowlands are western wheatgrass, vine mesquite, switchgrass, meadow dropseed, silver bluestem, big bluestem, indiangrass, alkali sacaton, Kentucky bluegrass, blue grama, sideoats grama, buffalograss, saltgrass, Canada wildrye, and several species of sedge. Major forbs and legumes are Baldwin ironweed, Missouri goldenrod, western ragweed, snow-on-the mountain, annual sunflower, heathaster, and Illinois bundleflower. Woody plants include Siberian elm, black willow, cottonwood, indiobush, amorpha, and buckbrush.

The Kansas Department of Health and Environment has developed surface water quality criteria.[6] The Department states that the high incidence of low flows in Wet Walnut Creek inhibit detailed water quality analyses and the application of water quality criteria.

Limited water quality data has been collected by the Kansas State Board of Health and Environment from Wet Walnut Creek near Ness City. This data is on the following page. This data is within the range of longer term records downstream at Albert. All measured factors with the exception of dissolved solids are within the limits of current accepted surface water quality standards.

There are no Types 3 through 20 wetlands in the watershed extensive enough to be included in the U.S. Fish and Wildlife Service Inventory for Kansas.[8]

Chemical Analyses of Wet Walnut Creek Streamflow Near Ness City[7/]

Concentration (mg/l.)

Date	Discharge (cfs)	SiO_2	Fe^{++} Fe^{+++}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	$CO_3^{=}$	$SO_4^{=}$	CL^{-}	F^{-}
3-11-68	.94	12	N.M.	107	23.0	70	13	300	0	171	73	.7
6-23-69	16.00	19	N.M.	54	8.2	21	15	176	0	50	23	.5
3-23-70	3.90	15	N.M.	94	20.0	70	13	278	0	150	73	.7

Date	NO_3^{-}	$PO_4^{\equiv}$	B	Dissolved Solids		Specific Conductance	Ratio of Specific Conductance to Dissolved Solids	pH
				Calculated	Measured			
3-11-68	3.5	2.6	.23	623	644	970	1.51	7.8
6-23-69	3.3	1.4	.21	282	283	450	1.59	7.5
3-23-70	1.3	3.4	N.M.	577	592	920	1.55	8.1

Economic Data

All land within the watershed is privately owned except for a small amount used for roads, public buildings, and similar purposes. There is no significant tract of publicly owned land. The 400 farm operating units within the watershed average 550 acres in size.

Farming operations in the watershed are primarily centered around wheat, grain sorghums, and forage sorghums. Some sorghums are used for livestock production. Alfalfa is grown under irrigation and on the flat bottomland near Wet Walnut Creek without irrigation.

Principal Crops and Current Yields

	Unit	Flood Plain (flood free)	Upland
Wheat	Bu	25	25
Sorghum			
Grain	Bu	40	39
Silage	Tn	12.0	9.0
Alfalfa	Tn	3.0	3.0

The number of farms in the watershed is decreasing at a rate of about one percent per year or less as the trend toward larger farms continues.

Selected data for 1969 includes:[28/]

	Watershed	State of Kansas
Median Family Income	$6,286	$8,693
Families with Incomes below Poverty Level	20.0%	9.7%
Unemployment Level	1.3%	3.9%
Family Income Distribution		
Less than $3,000	20%	11%
$3,000 to $10,000	57%	49%
Over $10,000	23%	40%

The source of income is generally sale of agricultural products. There are 56 family farms partially in the flood plain.

Land values in the watershed range from $750 per acre for leveled and irrigated flood plain cropland to $300 per acre for unirrigated upland cropland and $200 per acre for rangeland.

A good transportation grid serves the area. Kansas Highway 96 parallels the Wet Walnut Creek flood plain throughout the watershed and U.S. 283 is a north-south highway that crosses the watershed. State Highway 4, an east-west road, parellels the northern border of the watershed. The Atchison, Topeka and Santa Fe and Missouri Pacific railroads serve the watershed.

The watershed population in 1970 was 3,057 persons. This total included 2,469 town residents and 588 rural farm residents. By the year 2000 the watershed population is projected to increase from 3,057 to 3,277 with small town residents of 2,654 and rural farm residents of 623.

Fish and Wildlife Resources

Fish habitat is scarce and limited to warmwater species within the watershed. Portions of the mainstem of Wet Walnut Creek contain channel catfish, bullhead catfish, and carp. Privately owned and stocked farm ponds have largemouth bass, black crappies, white crappie, bluegill, carp, drum, channel catfish, and black bullhead catfish.[9/] The quality of these resources ranges from poor to excellent.

Woody wildlife cover, provided by cottonwood, honey locust, red cedar, willow, elm, ash, Russian olive, mulberry, and osageorange, is limited to riparian sites and shelterbelts.[10/] These wooded areas, along with the varied understory of shrubs, forbs, and grasses and adjacent croplands, provide critical habitat for upland game, deer, and other wildlife.

The effect of water quality on fish and wildlife, due to high sediment concentrations and inadequate quantities of water, has generally been damaging. At present, there are 55 miles of intermittent streams and 445 miles of ephemeral streams in the watershed.

Access is a primary factor limiting use of these resources. Most ponds and the land bordering streams are privately owned. Only individuals with landowner permission have access.

Deer hunting, based on permit drawings, occurs in the watershed. Upland game in the watershed includes bobwhite quail, mourning dove, ring-necked pheasant, fox squirrel, cottontail rabbit, and black-tailed jackrabbit. Upland game hunting, particularly for ring-necked pheasants, is important throughout the project area. During wet fall seasons, waterfowl use of marshy areas and potholes is extensive providing excellent hunting and birdwatching.

There are no known endangered or threatened plant species in the watershed.11/

The Kansas Academy of Science lists the endangered whooping crane (Grus americana) as a possible transient in the watershed.12/ The American peregrine falcon (Falco peregrinus), another endangered species, may be a transient or winter resident.

The bald eagle (Haliaeetus leucocephalus), the prairie falcon (Falco mexicanus), and the burrowing owl (Speotyto cunicularia) are listed as threatened species that might be found within the watershed. Although no recent sightings have been made, the endangered black-footed ferret may also be a resident within the watershed.

The Kansas Academy of Science's endangered or threatened species list contains no known fish, amphibians, or reptiles that might be found within the boundaries of Wet Walnut Creek Watershed.

Recreational Resources

There are no federal or state recreational developments in this watershed. The closest major recreational area is Cedar Bluff Reservoir, about 10 miles north. The Cheyenne Bottoms Waterfowl Management Area is about 45 miles east. The Cheyenne Bottoms area provides mostly public hunting with some fishing. A 31-acre state fishing lake 10 miles north of Dighton also provides some fishing. Water related recreation within the watershed is limited to farm ponds. During drought periods most farm ponds and streams dry up providing very few waters that will sustain a permanent fish population.

Archeological and Historical Areas

The National Register of Historic Places lists the Ness County Bank in Ness City as the only historic site in the watershed.[13]

The archeology of this region has received little systematic investigation in the past. There are 12 reported archeological sites within the region.

Data for the locations of previously known archeological sites along Wet Walnut Creek are primarily from the activities of amateurs and collectors reporting their work to the Kansas State Historical Society. The cultural time range known to be represented along Wet Walnut Creek is from the Paleo-Indian period to those of historic Indian tribes of the middle 19th century.

The Kansas State Historical Society reports no historic buildings or previously known archeological sites would be affected by the proposed structures.[14]

An inventory of archeological resources for the proposed structure locations prepared December, 1974, recommended[29]: (1) Testing to provide assessment and priority of archeological investigation for Structure Nos. 37, 38, 39, and 45, and (2) A revisit when collecting and subsurface conditions are more favorable for Structure Nos. 34, 41, and 42. All other proposed structures lack potential for prehistoric materials and no archeological evidence was found.

An assessment of archeological sites recommended by the inventory of December, 1974, was made in July and August, 1975, by a private archeologist in consultation with the State Archeologist.[31] The assessment report recommends the presence of an archeologist when the humus zone is stripped during construction of Structure Nos. 37, 38, and 45. This recommendation has been adopted. Testing at all other structures did not reveal sufficient cultural material to warrant further formal archeological investigation.

Soil, Water, and Plant Management Status

There are no major changes in land use trends.

The conservation district is active in the watershed. There are 320 cooperators and 157 basic plans have been developed covering 76 percent of the watershed. From 30 to 80 percent of the needed conservation practices have been applied. Fifty-three percent of the cropland and 38 percent of the rangeland is adequately treated.

Conservation districts receive technical assistance from the Soil Conservation Service. Other agencies with programs affecting land use and treatment in the watershed are the Cooperative Extension Service, the Forest Service, Farmers Home Administration, and the Agricultural Stabilization and Conservation Service. The Extension Service, through county agricultural extension agents, assists with informational and educational programs to carry out conservation objectives. The Agricultural Stabilization and Conservation Service shares the cost of installing certain permanent practices through its ACP or other programs. The Farmers Home Administration will make loans for the installation of conservation practices when other funds are not available to the farm operator. Through cooperative agreements with the Forest Service and the Kansas State and Extension Forester, all grassland and woodland acres in the watershed are within rural fire district protection.[15] The Forest Service and the Kansas State and Extension Forester have also assisted in 1,500 acres of tree and shrub plantings.

Presently 2,700 acres are under irrigation. The potential for further development is good. The present source of irrigation water is wells rather than surface water. The ground water supply is sufficient for current water demands including irrigation, but will not support expanding irrigation acreage.

In recognition of the general problem of declining water tables in some areas in western Kansas, the Kansas Water Resources Board and the U.S. Geological Survey undertook a cooperative study of ground water recharge using as the first study area Wet Walnut Creek in Rush County.[17] The report said the Wet Walnut aquifer depends almost entirely on the stream for its recharge and that the system is in balance at present. However, it noted that a long extended drought could seriously deplete the aquifer.

The aquifer in this watershed is shallow and is limited to a maximum storage of 70,000 acre feet. As of January, 1973, the aquifer contained 65,000 acre feet of recoverable water.

As of 1974, the average annual flood plain irrigation withdrawals were 3,900 acre feet. The identified average annual recharge from streamflow was 4,000 acre feet.

The months of July and August are the peak demand months for irrigation. Leaching is not a problem due to the good quality of alluvial aquifer waters used for irrigation and the characteristics of the irrigated soils.

The municipalities of Bazine and Ness City have a combined annual ground water withdrawal of 32 acre feet. The average depth of wells supplying this demand is 50 feet. Ness City has experienced occasional water shortages. Although the aquifer is in balance over the long term, the shallowness of the aquifer and its limited storage result in large fluctuations and near depletion during severe droughts. This is not a major industrial area. Any industrial development will probably continue to emphasize local services and agricultural product processing. It appears there will be no appreciable increased demand for additional water supplies in the watershed for municipal or industrial use in the near future.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and Water Management

Rangeland was first exposed to the plow in the middle 1800's. A gradual increase in cropland has occurred since the first plowing reaching a maximum around 1938. In 1974, 310 acres of rangeland were converted to cropland. An active land treatment program began in 1941. However, in 1974 conservation cropping systems were needed on 50,493 acres of cropland; rangeland and woodland conservation practices were needed on 47,123 acres.

Erosion is a problem on cultivated uplands where needed land treatment has not been installed. The average cropland soil loss is 4.9 tons per acre per year. Soil loss results in depletion of soil resources, reduction of crop yields and income, sedimentation in farm ponds and on the flood plain,

as well as deterioration of stream quality and increases in road maintenance costs.

Most landowners are economically able to install needed land treatment with the help of federal cost-sharing programs.

Soil fertility is not generally a problem; however, low fertility becomes a problem on eroded lands. Available soil moisture is a limiting factor in crop production in most years. Moisture conserving practices such as stubble mulching, terracing, and contour farming are needed on cropland. Excessive tillage operations on many farms reduces ground cover; increases compaction, crusting and runoff; and uses more fuel than necessary. Land use adjustments needed are mostly cropland to grassed waterways.

Floodwater Damage

Damage resulting from flooding (1.5 year frequency or greater event) is a principal watershed problem. Two recent floods stand out in the memories of watershed residents: the floods of 1959 and 1967. Both floods caused damage to most bottomland in the watershed.

The evaluated flood plain covers 1,594 acres and includes 1,194 acres of cropland. Crop and pasture damage due to flooding averages $7,000 annually and accounts for 78 percent of the total direct floodwater damage.

Damages by floodwater occur throughout the flood plain of the watershed. A total of 56 farm units are subject to damage.

Flood damages occur on 15,300 acres off-project immediately downstream from Subwatershed No. 1 on the Wet Walnut Creek flood plain. Part of this area is comprised of: urban and suburban, 320 acres; cropland, 9,910 acres; and pasture and miscellaneous lands, 2,870 acres. The remainder occurs on flood plain common with the Arkansas River and is comprised of: urban and suburban, 680 acres; cropland, 1,290 acres; and pasture and other land, 230 acres. Flood damages also occur on 32,467 acres in Subwatersheds Nos. 1 and 2.

Flooding causes damage to buildings, fences, machinery, cattle and hog pens, feed bunks, and stock tanks. Considerable expense is incurred for cleanup of debris after flooding. Agricultural damages of this type average $1,000 annually.

Floodwater damage to roads and bridges averages $1,000 annually. Floods wash away road surfacing, scour road shoulders, fill road ditches with mud on 0.8 mile of road, and damage 6 bridges. County and township budgets are not usually sufficient to make timely replacements and repairs following floods. This work is necessarily spread over a number of years, hence these essential facilities remain in a subnormal condition.

Small, localized floods frequently cause considerable damage and inconvenience to farmers in the watershed. A major flood, such as the one experienced in May 1967, affects everyone in the area, due to damaged roads, bridges, utilities, and loss of business to those serving the agricultural community. Such indirect losses are estimated at $1,100 annually. The 1967 flood peak at Ness City exceeded the highest known previous mark by about six feet. A flow of 50,000 cubic feet per second was estimated at Ness City. In a four-hour period four to twelve inches of rainfall, accompanied by hail, fell over a 150 square mile area northwest of Ness City. Wet Walnut Creek was out of its banks throughout the watershed.

In summary, total average annual direct floodwater damages are an estimated $9,000 as shown in Table 5. There are also unevaluated damages to wildlife in the flood plain. Ground-nesting birds are especially hard hit by floods occurring between April and August, the period of occurrence of 75 percent of the floods. Flooding destroys protective habitat, nests, and young birds. Terrestrial species in the flood plain may be displaced or killed by floods. Displacement may result in increased predation, starvation, or disease epidemics.

Erosion and Sediment Damage

The highest soil losses occur on cropland. Average annual soil loss from cultivated upland fields ranges from 1 to 14 tons per acre with an overall average of 4.9 tons per acre. Some steeply rolling rangeland is gullied. Average annual soil loss from rangeland is 1.5 tons per acre.

Large floods cause flood plain scour damage. The average annual erosion damage due to scour is $1,600.

Sediment deposition on the flood plain is restricted to overbank deposits along the channel of Wet Walnut Creek and its tributaries. These deposits occur as a result of high intensity rainfalls. Some deposition has occurred and is still occurring in channels. The average annual flood damages caused by channel deposition is estimated at $400.

The annual sediment yield per square mile ranges from 250 to 550 tons in the watershed. An estimated 170,000 tons of sediment are delivered to the Arkansas River annually from the Wet Walnut Creek Basin. This watershed contributes an estimated 41,000 tons of sediment annually to the Arkansas River. Sediment yield from this watershed is 47,700 tons per year.

The average suspended sediment concentration of Wet Walnut Creek above Bazine is estimated at 2,100 mg/l. Such high concentrations inhibit desirable stream flora and fauna. Murky waters are a common occurrence in Wet Walnut Creek.

Recreation

The Kansas State Outdoor Recreation Plan indicates that the single most important outdoor recreation need in this area is water.[16/] In 1970 the five-county area had a population of 48,884. Within a 50-mile radius about 128,200 people lack sufficient recreational facilities to satisfy needs. By the year 2000 this area's population will be about 137,400.

Fishing in the Wet Walnut Creek is poor because of sediment pollution and low water quantity. Fishing in watershed farm ponds ranges from poor to excellent depending on water quality, permanence, and management. Most fishing is restricted to family and close friends of landowners. The need exists for a stable fishery available to the public. There are no public lands within the watershed which may be used for fishing or hunting.

Fish and Wildlife

There is a need for more wildlife habitat, particularly cover, throughout the watershed. A substantial increase in cover would tend to be in competition with agricultural production, although some compatible increases are possible.

Economic and Social

The watershed is not an economically depressed area. It is composed of family farms. None of the farms in the district use one and one-half man years or more of hired labor at present. There is a need to provide additional employment opportunities in order to give young people options other than migration to an urban area. There is a general need to establish rural community development in the watershed.

Other

A need exists for outdoor educational facilities.

PROJECTS OF OTHER AGENCIES

While there are no major projects proposed by other agencies within the watershed, the Corps of Engineers has an authorized local flood protection project at Great Bend. This project and the watershed projects are complementary. The watershed projects would supplement the protection offered in Great Bend. One effect of the watershed projects will be to reduce the Corps of Engineers standard project storm peak discharge by 35 percent. The local flood protection project would protect Great Bend from floods on both the Arkansas River and Wet Walnut Creek. The current estimated cost is $18.4 million, of which $3.7 million would be non-project Construction of the local flood protection project is pending passage of a bond issue by local voters.

PROJECT FORMULATION

Subwatershed No. 3 is one of five watersheds in the Wet Walnut Creek Watershed Joint District Number 58 which covers the entire Wet Walnut Creek basin except for the lower few miles. The five watersheds were planned concurrently. One

of the watersheds proved economically unfeasible for a P.L. 566 program. The watershed district has complied with applicable Kansas laws while organizing and carrying out their activities.

Shortly after the flood of September 1959, the first steering committee was selected. Interested citizens held their first public meeting May 8, 1961. The 18 banks of the area provided funds for organizing the watershed. Petitions calling for a formal vote were submitted to the Secretary of State May 16, 1963. The first Board of Directors was elected July 11, 1963. A favorable vote was taken October 29, 1963. A Certificate of Incorporation was issued by the Secretary of State November 22, 1963.

An application for federal assistance under P.L. 566 was submitted to the State Soil Conservation Committee September 30, 1964. Approval by the State Soil Conservation Committee was granted December 18, 1964. A joint study of Wet Walnut Creek as a part of the Upper Arkansas basin by the Soil Conservation Service, Forest Service, Economic Research Service, and the Kansas Water Resources Board was started May 4, 1965. The State Soil Conservation Committee assigned a priority for planning July 31, 1967. A ground water recharge study was started in the Wet Walnut Creek basin as a cooperative venture of the Kansas Water Resources Board, the U.S. Geological Survey, and the Wet Walnut Creek Watershed District during the summer of 1968.

Preliminary planning led to project formulation meetings where 54 sites were selected for P.L. 566 status and 45 additional sites were selected to be built with other federal assistance programs over the five watersheds. Most of these sites remain in the plans. Planning was authorized by the Soil Conservation Service Administrator January 13, 1969.

The watershed board of directors maintains an active and continuing interest in promoting conservation of all kinds within the district. They employ full-time a watershed manager and have held public meetings monthly throughout the history of the district. In the course of these activities, many alternatives have been considered. The public has had ample opportunity and repeated encouragement to provide inputs

into the development of the objectives and project formulation. The local press has given extensive coverage to the activities of the district and the general level of public awareness of the plans is very high.

The General Plan for Wet Walnut Creek Watershed Joint District Number 58 was approved by the Board of Directors and the Kansas Division of Water Resources of the State Board of Agriculture March 30, 1972.[25] Modifications were made and approved in February, 1973, and January, 1974. Well publicized public hearings were held at each of these steps.

Objectives

Original goals of sponsors were expressed in the applications dated September 30, 1964. The goals were stated in general terms of types by benefits expected through project action. As planning progressed the goals became more specific and better defined. The redefined goals, including those of the Soil Conservation Service, are summarized herein according to project purpose.

Watershed Protection (Conservation Land Treatment): Reduce soil loss on 52,000 acres of cropland and 30,000 acres of rangeland to allowable levels. The allowable soil loss for a typical upland soil is 5 tons per acre per year.[1]

Manage land within its capability. Manage croplands through implementation of conservation practices: conservation cropping systems, stubble mulching, minimum tillage, contour farming, and the installation of terraces, diversions, grassed waterways, and drainage systems. Convert cropland to rangeland where appropriate and improve management practices on existing rangeland. Manage rangelands through proper grazing use, planned grazing systems, brush management, and the strategic placement of stock ponds.

Reduce sediment load to a point that no new deposition occurs in the main Wet Walnut Creek channel. The objective is to maintain or improve present capacity and ground water recharge capacity of the channel.

Flood Prevention: Reduce average annual flood damages to crops, agricultural properties, roads, bridges and public

utilities by 60 percent on 38,500 acres of flood plain within the watershed district. Reduce flooding in urban areas to confine damage to streets, lawns, and parks.

Recreation: Develop one reservoir with the best physical potential for multipurpose use including recreation. Design facilities for maximum potential use for fishing, boating, sightseeing, picnicking, hunting, and camping.

Fish and Wildlife: Enhance fish and wildlife resources within the watershed through land treatment measures, land use conversions, and establishment of impounded water. Where habitat losses unavoidably occur due to installation of structural measures, they are to be mitigated.

Outdoor Education: Cooperate with school districts to develop outdoor educational areas in conjunction with reservoirs where practical. These areas should be located to serve four unified school districts.

Alternatives

Eight alternatives considered in formulation of the project plan are displayed in the table on the next page. These alternatives were analyzed for physical feasibility, source of authority, availability of local sponsors, effect on adverse environmental impacts, viability and cost. A viable alternative is defined as one which is physically feasible and could be carried out under an existing authority. Cost estimates are included only for viable alternatives that reduce or eliminate adverse impacts of the proposed project.

Alternative No. 3-1 is the same as the proposed project except that sediment pools of floodwater retarding structures would be dry. These dry impoundments would convert 13 miles of ephemeral streams and associated flood plains to 636 acres of freqently flooded odd area habitat. The project, on an average annual basis, would add 4,000 acre feet of additional ground water and increase evapotranspiration by 1,900 acre feet. The aesthetics and incidental benefits associated with the development of 636 acres of aquatic habitat would be foregone. The cost of this alternative would be $6,318,500.

WET WALNUT CREEK SUBWATERSHED NO. 3

MATRIX ANALYSIS OF ALTERNATIVES (X=yes, 0=no)

Alternative No.	Description	Alternative Components: ACC LT	MP-REC	CW	Z & I	FRS No.	Physical Feasibility	Authority: PL 566	Authority: Other	Local Sponsorship	Effect on Adverse Impacts	Viable	Installation Cost ($)
3-1	As planned, but with dry pools	X	X			12	X	X	0	X	Reduce	X	6,318,500
3-2	No project						X		X	X	Eliminate	X	1,548,500
3-3	Acc. L.T.	X					X	X	X	X	Eliminate	X	2,011,000
3-4	Acc. L.T. and non-structural measures	X			X		X	0	0	0	Eliminate	0	
3-5	Acc. L.T. and Site Nos. 43, 44, and 45	X				3	X	X	0	X	Reduce	X	3,568,000
3-6	Channel Work and Acc. L.T.	X		X			X	X	X	X	Increase	X	
3-7	Recharge structures and Acc. L.T.	X					X	0	X	X	Reduce	X	3,215,400
3-8	As planned with recharge structures	X	X			12	X	X	X	X	Increase	X	

ACC LT - Accelerated land treatment (all alternatives include on-going land treatment)
MP-REC - Multipurpose Floodwater Retarding and Recreation Structure
CW - Channel Work
Z & I - Flood Plain Zoning and Flood Plain Insurance
FRS - Floodwater Retarding Structure

Alternative No. 3-2 is to allow present trends to continue. The existing land treatment program would continue. Average net benefits of $92,700 would be foregone.

Alternative No. 3-3 consists of accelerated land treatment. Resource management systems would be installed in 10 years on 82,380 acres of agricultural land. The average annual soil loss from upland soils would be reduced from 3.7 to 2.6 tons per acre. Average annual sediment deposition in existing ponds would be reduced 30 percent and the average annual sediment yield to the watershed outlet would be reduced from 47,700 to 33,600 tons. The cost of this alternative would be $2,011,000.

Alternative No. 3-4 is the same as Alternative No. 3-3 with the addition of flood plain management including zoning to those uses best adapted to flooding. Agricultural use of flood plain land will be controlled. State law prohibits restriction of agricultural use of land. Flood insurance would be made available to all communities. This alternative would require additional studies for evaluation.

Alternative No. 3-5 consists of accelerated land treatment and three floodwater retarding structures. The floodwater retarding dams and spillways would occupy 86 acres now in crops and 98 acres now in grass. The pools would convert 4 miles of ephemeral streams and associated flood plain to 763 acres of aquatic habitat. Flooding and sediment deposition would increase above the proposed structures on 373 acres of cropland and 390 acres of rangeland and pastureland. Identified flood damages would be reduced 30 percent on 1,600 acres of flood plain below the proposed structures. The accelerated land treatment would improve the soil, water, and plant management on 82,380 acres. The average annual soil loss from upland soils would be reduced from 3.7 to 2.6 tons per acre. The average annual sediment deposition in existing ponds would be reduced 30 percent; and average annual sediment yield to the watershed outlet would be reduced from 47,700 to 30,400 tons. The project would add 800 acre feet of ground water and increase evapotranspiration by 900 acre feet annually. The cost of this alternative would be $3,568,000.

Alternative No. 3-6 consists of accelerated land treatment and channel work to achieve the flood reduction benefits provided by the project. Channel work would be enlargement and realignment, or confinement by dikes, of approximately 14 miles of intermittent stream. While flood benefits as large as the planned project could be obtained, flooding would be increased downstream. Achievement of damage reduction comparable to the planned project would cause loss of riparian and stream channel habitat and increase downstream flooding.

Alternative No. 3-7 consists of five low-head dams on the mainstem channel for ground water recharge, annual cleanout of the pools created by the dams, and accelerated land treatment. The pools would inundate 14 miles of intermittent stream. The low-head dams would increase flood damages by 7 percent on 1,594 acres of flood plain. In 10 years resource management systems would be installed on 82,380 acres of agricultural land. The average annual upland soil loss would be reduced from 3.7 to 2.6 tons per acre. The average annual sediment deposition in existing ponds would be reduced 30 percent; and the average annual sediment yield to the watershed outlet would be reduced from 47,700 to 16,000 tons. The project would add 400 acre feet of ground water and increase evapotranspiration. Average annual discharge of Wet Walnut at Alexander would be reduced 900 acre feet. The project would result in $700 average annual increase in flood damages. The average annual cost of cleanout and maintenance of the pools and maintenance of the dams would be $57,800. The installation cost of the project would be $3,215,400.

Alternative No. 3-8 is the planned project plus low-head dams on the mainstem channel for additional recharge. The pools created by the low-head dams would inundate an additional 14 miles of intermittent stream. This alternative would not reduce flood damages as much as the planned project. This alternative would provide 5,800 acre feet of additional ground water and increase evapotranspiration 200 acre feet. The average annual discharge at Alexander would be reduced 7,600 acre feet. The average annual cost of cleanout and maintenance of the pools and maintenance of the dams would be $38,300.

All viable alternatives were evaluated in terms of their effects on watershed problems and planning objectives.

Alternatives which provided the maximum reduction in average annual flood damages for the watershed were considered most desirable for the following reasons:

The flood plain is already extensively used, mostly for agricultural enterprise. Any reduction in present or future agricultural use of the flood plain would be undesirable as an alternative because of the importance of agricultural production to the area's economy.

Additionally, sponsors felt that the reductions in adverse effects (see effects section) that would be achieve by eliminating recreational use were not sufficient to justify the loss of benefits.

After consideration of all viable alternatives that could reduce or eliminate adverse project effects, the proposed project, which includes conservation land treatment, 1 multi-purpose structure, and all economically justifiable floodwater retarding structures was selected.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Resource management is essential to a sound watershed protection and flood prevention program. Farmers and ranchers, in cooperation with the conservation district, will develop conservation plans to achieve proper land use and conservation.

Adequate land treatment will be implemented on 52,000 acres of cropland, 30,000 acres of rangeland, and 380 acres of forestland. Conservation agreements must be obtained from operators of at least 50 percent of the land in drainage areas above reservoirs before construction of the structure is started. Additionally 75 percent of the effective land treatment measures must be applied to sediment source areas which, if uncontrolled, would require a material increase in the cost of construction, operation, or maintenance of the structural measure. Provisions for installation of these measures before or concurrent with construction must be made in each project agreement. The resource management systems will include all practices that are needed for desired and compatible use of a particular land area. Land use conversions needed to establish proper conservation of the watershed include 8,207 acres of cropland to: hayland

(640 acres), rangeland (7,000 acres), wildlife and recreation land (382 acres), forestland (60 acres), and other uses (125 acres); and 387 acres of rangeland to wildlife and recreation land.

Alternative conservation practices for cropland resource management systems include:

Conservation Cropping System: Using needed cultural and management measures for crops. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without these crops.

Stubble Mulching: Managing plant residue on a year-round basis in which harvesting, tilling, planting, and cultivating are performed to keep protective amounts of vegetation on the soil surface.

Minimum Tillage: Limitation of cultivation to that essential to crop production and prevention of soil loss.

Gradient Terraces: A system of earth embankments, ridges and channels, constructed along a slope at a suitable spacing and with an acceptable grade.

Level Terrace: An earth embankment or a ridge and channel constructed across the slope at a suitable spacing with no grade.

Diversion: A channel with a supporting ridge on the lower side constructed across a slope. Diversions are constructed to divert water from areas where it is in excess to sites where it can be used or disposed of safely.

Contour Farming: Cultivation of sloping land at right angles to the slope. This includes following established grades of terraces, diversions, or contour strips.

Grassed Waterway or Outlet: A natural or constructed passageway for water with vegetation established that is suitable for safe disposal of runoff from a field, diversion, terrace, or other structure.

Drainage: Disposal of excess water in a field by grading to reshape the land surface or by construction of a graded ditch.

Artificial Ground Water Recharge System: A conservation practice system for temporary surface storage of excess runoff to be infiltrated into the soil and percolated to the ground water table.

Rangeland is used for grazing livestock and big game animals. The natural plant community is dominated by grasses, grass-like plants, forbs, legumes, and shrubs. The primary practices among alternatives for rangeland are:

Proper Grazing Use: Grazing at an intensity which will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation. This can be accomplished by stocking at rates compatible with forage production where summer-long grazing is practical or by rotating grazing use between two or more pastures. Cropland forage to produce seasonal pasture, hay, or silage can be planned to supplement rangeland pastures.

Planned Grazing Systems: A system in which two or more grazing units are alternately rested from grazing in a planned sequence over a period of years. The rest period may be throughout the year or during part of the growing season of the desirable plants. Many pastures in the watershed contain sufficient amounts of desirable plants to recover rapidly through periodic deferments.

Brush Management: Manipulation of stands of brush by mechanical, chemical, or biological means. This includes reducing excess brush and weeds to restore natural plant community balance and manipulation of brush stands through selective and patterned control methods to meet specific needs of the land and objectives of the land user.

Range Seeding: Establishing adapted plants by seeding on rangeland.

Pond: A water source for livestock made by constructing a dam or embankment or by excavating a pit.

Detention Dam: A dam or embankment to temporarily detain floodwater to regulate the rate of flow in a watercourse.

Woodland is used primarily to produce adapted woody plants, to provide cover to protect fields and farmsteads from inclement

weather, and to supply watershed protection, wildlife habitat, and landscape diversity. For optimum maintenance or improvement of hydrologic conditions, woodland must support vigorous, fully stocked stands of trees with undisturbed ground cover. Benefits from woodland management will be sustained by realizing the maximum economic returns consistent with site capabilities. To obtain these objectives, the following land treatment measures will be employed:

Woodland Improvement: This may include harvesting mature trees, removing poor quality or less desirable trees, and pruning the managed species.

Windbreak and Shelterbelt Planting and Renovation: Planting tree and shrub seedlings to establish new, or renovate existing shelterbelts and windbreaks. Renovation may also include the removal or pruning of existing plants or the adoption of improved management practices.

Hedgerow Replacement or Renovation: Hedge seedlings may be planted to establish permanent field borders and add to wildlife habitat and landscape beautification.

Grazing Control: Grazing can damage young trees and cause soil erosion and compaction. All new plantings and cultural operations should be protected from grazing livestock. Some good quality young native timber also needs protective fencing.

Tree and Shrub Plantings: Special shelterbelt plantings are planned for each flood control structure to break up summer winds and thereby reduce evaporation. These plantings are planned to maximize their value for wildlife habitat, recreation shelter, and site beautification. Plantings in other areas will serve similar purposes.

An educational program is planned to inform rural residents of the economic and wildlife benefits that can be gained from excluding livestock from woodlands and shelterbelts.

A forestry work plan was developed for the watershed by the Kansas State and Extension Forester, in cooperation with the U.S. Department of Agriculture, Forest Service.[15] Forestry technical assistance provided through the existing Cooperative Management Program and P.L. 566 Program will adequately serve the needs of the watershed woodlands throughout the life of the project.

Although the watershed area is protected by rural fire districts, new districts need to be organized as a response to additional documented fire protection needs. Fire prevention education programs will be developed. Technical assistance for fire control measures will be provided by the Kansas State and Extension Forester.

Cost of improved fire control equipment and facilities is to be borne by rural fire districts. Technical fire control assistance will be provided from going programs.

As part of the land treatment measures to be installed, the watershed district, in cooperation with the conservation district, will work with landowners to install approximately nine detention dams. These dams will control drainage areas ranging in size from 1.41 to 6.12 square miles for a total of 34.39 square miles or 9.5 percent of the drainage area in the watershed. These dams will provide detention of runoff water averaging 2 inches per square mile. The total estimated flood storage for the nine detention dams is 3,600 acre feet. Sediment pools will store 730 acre feet.

Watershed directors and conservation district supervisors are furnishing part-time technical assistance to accelerate the installation of soil and water conservation treatment. Provisions have been made for personal contact with landowners and operators to urge them to establish conservation practices on their farms. During this contact, people will be informed about the watershed program and its progress. Underlying these efforts is the importance of landowner-operator understanding that these treatment measures not only benefit them individually but also are necessary prior to building floodwater retarding structures in the watershed.

Structural Measures

A system of 11 floodwater retarding structures and 1 multipurpose structure with recreational facilities will be installed at locations shown on the project map.

All structures will be earth dams with vegetated emergency spillways provided to release runoff exceeding reservoir storage capacity safely past the dam. All foundations are classified as yielding and consist mostly of silty clay.

Emergency spillways have been planned so that their chance of operation in any one year is two percent or less. A cross section of the typical structure is shown in Figure 1, page 75.

At all sites the predominant emergency spillway material to be excavated is silty clay. The remaining material to be excavated will be shale and limestone.

The predominant borrow material at all sites will be silty clay. The intended borrow area for all sites is the sediment pool area and emergency spillway excavation. Clearing will be necessary in the borrow areas; however, any opportunity to retain trees and brush will be given special consideration.

All structures will have a drop inlet type principal spillway with single stage inlets near the elevation of the estimated 100-year accumulation of sediment. Principal spillways will be reinforced concrete, or a material of comparable quality and strength. Average uncontrolled release rates of 3.5 cubic feet per second per square mile of drainage area above the structure will not exceed downstream channel capacities.

Natural streamflow is to be passed through the dams to meet downstream water rights as provided by the Kansas Water Appropriation Act. Principal spillways will include 8-inch minimum diameter drawdown pipes with control valves to permit low flow releases regardless of reservoir storage elevation.

The floodwater retarding structures will have a total of 24,885 acre feet of floodwater storage. Retarding storage will vary from 2.20 to 3.85 inches of runoff from the drainage area. Drainage area controlled by the structures will range from 4.90 to 43.80 square miles. A total of 49.6 percent of the drainage area in the watershed will be controlled. Sediment storage will be provided for the expected 100-year accumulation of 2,895 acre feet. Sediment storage volumes vary from 0.22 to 0.44 inches from the drainage areas.

All structural measures are designed for 100-year life. The multipurpose reservoir is planned to store 849 acre feet for floodwater retarding storage, 287 acre feet of recreational water, and 68 acre feet of sediment.

The recreation pool will have a full pool surface area of 40 acres 33 percent of the time. A 24-acre pool will be available for recreational use 80 percent of the time. Sixteen acres below the full pool will be exposed around shoreline 20 percent of the time. The pool will have a maximum initial depth of 26 feet and an average initial depth of 8.9 feet. The average depth at the end of 100 years is estimated to be 7.2 feet. The estimated time for initial filling of the recreational pool is one year.

Two hundred acres of land will be purchased in association with the multipurpose structure. This land includes 120 acres for recreational use and floodwater detention, and 80 acres to insure full use of the recreational facilities. Flowage easements will be obtained on an additional 25 acres.

All borrow areas for the multipurpose structure will be located on purchased land.

Sponsors will provide public access to recreational facilities at the multipurpose reservoir. All recreational facilities will be installed, operated, and maintained to meet or exceed the requirements of state and local public health agencies. In addition, HEW standards will be used as guidelines.[26/] Facilities will be designed and constructed to be usable by the physically handicapped.

Sediment pools in all the floodwater retarding structures will have some potential for limited recreational use. Access to these structure sites will be controlled by landowners. Access by the general public will be prohibited unless or until adequate sanitary facilities are provided to meet state and local health requirements. The watershed district will notify the State Department of Health and Environment if adequate sanitary facilities are not provided.

If the multipurpose reservoir is eventually officially designated a "body contact area" by the Kansas State Department of Health, the Kansas Forestry, Fish and Game Commission will be responsible for regular monitoring of water quality in the lake in accordance with the state code for Class A waters. This requirement does not prohibit use of the lake for body contact water sports prior to such designation.

Facilities for full use of the multipurpose structure will be installed during the project period as described in Table 2B. These include fencing, signs, access roads, parking, drinking water, picnic facilities, sanitary facilities, and facilities for boating. Random of primitive camping areas will be available.

A road will be raised during installation of Structure No. 38. Installation of Structure Nos. 37, 41, and 42 will involve raising a road and bridge. See Table 2 for estimated costs. An easement will be required on a railroad right-of-way at Structure No. 40.

Record search and field examinations confirm abandoned oil or gas wells in the reservoir areas to be adequately plugged. No producing gas or oil wells will be affected by structural measures.

Outdoor educational laboratories at Structure Nos. 37 and 41 are proposed by the watershed district in cooperation with four school districts. An estimated 1,900 students will be served annually. Nature trails are planned to provide maximum use of existing vegetation and geological formations. The Kansas State and Extension Forester will assist with additional plantings to enhance the educational value of the area. This development will also provide an environment favorable to wildlife. Windbreaks, grass borders, controlled mowing, maintenance of den and nut trees, and construction of brush piles will help increase wildlife populations. Classes will be developed to help students learn proper use and conservation of natural resources. Costs for the outdoor educational laboratories are nonproject costs to be paid for by the school districts.

As a result of land acquisition for multipurpose Structure No. 34, it is estimated that two persons on one farm operation will be eligible for relocation payments. As a result of installation of Structure Nos. 36 and 39, it is estimated that two persons on one farm operation associated with each structure will be eligible for relocation payments. Relocation payments of $3,000 for Structure No. 34, $5,000 for Structure No. 36, and $3,000 for Structure No. 39 are included in the estimated structural cost distribution shown in Table 2.

Specific measures to offset wildlife losses and enhance habitat have been recommended for each structure site. Maps and descriptions of these measures are included in a report by the U.S. Fish and Wildlife Service.[10/]

Compensating measures have been adopted as design features for each structure. The dams and spillways of the 11 floodwater retarding structures will be fenced and seeded to a grass-legume mixture suitable for wildlife. The fee title area of the multipurpose structure will be fenced and the dam and spillway will be seeded to a grass-legume mixture suitable for wildlife. Specific odd areas adjacent to Structure Nos. 37, 38, 44, and 45 as designated in the Fish and Wildlife Service Report are to be within the permanently fenced and seeded area. Tree and shrub plantings are to be made in the designated areas for Structure Nos. 37 and 44. Mature trees will be preserved where possible.

Enhancement measures recommended in the Fish and Wildlife Service report for installation by the sponsors at the floodwater retarding structures include: additional odd areas and tree and shrub plantings be included within the permanently fenced area; seeding cropland within a one foot vertical elevation of the sediment pool to switchgrass; leaving as much woody vegetation within the sediment pools as possible; constructing brush piles suitable for wildlife using trees cleared for construction; and planting borrow areas within the sediment pools to a quick cover crop. None of the enhancement measures have been adopted as a part of this plan.

The need for water and air pollution abatement during construction will be determined on a site-by-site basis. Abatement measures may include dry stream crossings, temporary vegetative establishment, watering for dust control, controlled burning, and sediment control basins.

The State Archeologist will be notified in advance of stripping operations of Structure Nos. 37, 38, and 45 so that an archeologist may be present.

The Soil Conservation Service will in consultation with the State Historic Preservation Officer maintain close communication with the State Archeologist during project construction so that any finds may be investigated to determine the need for emergency salvage. The National Park Service will also be notified of any discoveries. If necessary, the Secretary of the Interior will be asked to determine the site's eligibility for inclusion on the National Register. The Advisory Council on Historic Preservation will be requested to comment on any site affected by project activities which have the qualities to make it eligible for inclusion in the National Register of Historic Places. This is in accordance

with section 106 of the National Historic Preservation Act, PL-89-665, 16 USC 470(f). Since this is a federally assisted local project, there will be no change in the existing responsibilities of any federal agency under Executive Order 11593 with respect to archeological and historical resources.

EXPLANATION OF INSTALLATION COSTS

Needed land treatment measures and their estimated costs are shown in Table 1. The estimated total planning and installation cost for land treatment is $2,011,000. Public Law 566 funds will provide $89,300 of this total for technical assistance to accelerate the current program. Other sources will provide the remaining $1,921,700 for installating these measures. Land treatment installation costs include nine detention dams. All land treatment cost estimates are based on present costs under current programs.

Structural measures and their estimated costs are also shown in Table 1. These costs are separated by individual structure sites in Table 2. The total estimated cost for all structural measures is $4,533,600. The following discussion of structural measures costs deals first with the major elements listed in Table 1 (construction, engineering services, relocation payments, project administration, and land rights). Next is an explanation of the estimated structural cost distributions found in Table 2.

Construction cost estimates are based on topographic survey data and unit costs of similar work on other projects. A contingency allowance of 12 percent was used; however, no unusual construction problems are anticipated.

Engineering services include all direct and related costs of surveys, geologic site investigations, soil mechanics, structure design, construction plans, and specifications.

Relocation payments are made to those landowners and farm operators who are displaced from their farm operations. These costs include moving and expenses of searching for a replacement farm location or payments for direct loss of personal property if the farm operation is not relocated. The estimated total relocation payments are $11,000. Public Law 566 funds will pay 62.2 percent or $6,900, and other sources will pay 37.8

percent or $4,100. The cost-sharing percentages are based on the ratio of P.L. 566 funds and other funds to total project costs, not including relocation payments. The sponsors and the Service will be involved in administrative functions in connection with relocation payments. Each will bear the costs they incur.

Project administration costs are P.L. 566 and other administrative costs associated with installation of structural measures. These costs include contract administration, review of engineering plans prepared by others, and necessary inspection service during construction to see that structural measures are installed in accordance with plans and specifications. Project administration costs to the district also include relocation assistance advisory services. These services shall provide: (1) measures or facilities necessary to determine relocation assistance needs, (2) information regarding replacement property, (3) informational brochures, (4) assurance of replacement dwellings, and (5) assistance in getting established. In addition to relocation assistance advisory services, the sponsors and the Service will be involved in administrative functions in connection with relocation payments. The sponsors and the Service will each bear the costs they incur. These shall include costs for: (1) serving notice of displacement, (2) providing application forms, (3) assisting in filing applications, (4) hearing and resolving grievances, and (5) making relocation payments. The Service will assist the sponsors in carrying out these administrative functions.

All land values were determined by the Wet Walnut Creek Watershed Joint District Board of Directors and agreed to by the Soil Conservation Service, where the watershed district is to pay the entire cost. Land cost estimates are based on current land values which vary from $200 per acre for grassland to $750 per acre for leveled and irrigated cropland. For structures where land rights are cost shared, the Service and the Kansas Forestry, Fish and Game Commission determined the values. Land cost estimates also include appraisal fees. Estimates may not coincide with actual out-of-pocket costs to the local sponsoring organizations because some easements may be donated. Land cost estimates for the recreational site are based on $200 per acre.

Construction and engineering cost for the multipurpose site, excluding recreational facilities, will be allocated on the basis of the "use of facilities" method. Allocations computed in this manner are: flood prevention, 76.2 percent, and public recreation, 23.8 percent. Construction costs will be cost shared as follows:

Item	Sponsoring Local Organizations		P. L. 566		Total	
	%	Costs($)	%	Costs($)	%	Costs ($)
Flood Prevention	0	0	100	146,100	100	146,100
Public Recreation	50	22,900	50	22,900	100	45,800
Total	11.9	22,900	88.1	169,000	100	191,900

The engineering cost for the multipurpose structure is estimated at $30,700. All of these costs are paid by P.L. 566 except for $2,400 of the $3,200 required for recreational facilities.

Land rights for the multipurpose reservoir and the recreational facilities and development are to be acquired on 200 acres at an estimated cost of $44,200. These costs will be shared as follows:

Item	Sponsoring Local Organizations		P. L. 566		Total	
	%	Cost	%	Cost	%	Cost
Dam and Reservoir Fee Title - 120 acres	50	12,000	50	12,000	100	24,000
Recreational Area 80 acres	50	8,000	50	8,000	100	16,000
Surveys, Legal Fees, etc. (includes easement on 25 acres)	100	4,200	0		100	4,200
Total		24,200		20,000		44,200

Costs paid with P.L. 566 funds for the 11 floodwater retarding structures include all the construction and engineering services costs. Part of the project administration costs will also be paid from P.L. 566 funds. The district will pay the land rights costs including necessary road and bridge modification costs.

The total project administration cost is estimated to be $1,098,200. Public Law 566 will bear $1,003,800 of this cost and other funds will pay the remaining $94,400. The Service and the sponsors will each bear the costs they incur.

The total estimated installation cost of the 11 floodwater retarding structures and 1 multipurpose structure is $3,435,400. These costs, in relation to purpose and cost sharing, are shown in Table 2A.

Estimated total P.L. 566 costs and other obligations by fiscal years during the project installation period are as follows:

Land Treatment

Fiscal Year	P.L. 566 Costs	Other Costs	Total
First	$ 4,500	$ 96,100	$ 100,600
Second	13,400	288,300	301,700
Third	13,400	288,300	301,700
Fourth	13,400	288,300	301,700
Fifth	13,400	288,300	301,700
Sixth	8,900	192,200	201,100
Seventh	8,900	192,200	201,100
Eighth	4,500	96,100	100,600
Ninth	4,500	96,100	100,600
Tenth	4,400	95,800	100,200
Total	$89,300	$1,921,700	$2,011,000

Structural Measures

Fiscal Year	P.L. 566 Costs	Other Costs	Total
First	$ 158,300	$ 76,100	$ 234,400
Second	447,300	88,400	535,700
Third	386,500	54,000	440,500
Fourth	403,500	51,100	454,600
Fifth	413,000	47,800	460,800
Sixth	449,800	61,000	510,800
Seventh	402,900	74,900	477,800
Eighth	414,400	41,600	456,000
Ninth	458,300	41,600	499,900
Tenth	444,300	18,800	463,100
Total	$3,978,300	$555,300	$4,533,600

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention, Erosion, and Sediment

The planned project will reduce the 100-year flood near Bazine from 23 to 12 csm and would eliminate flood damage up to the 10-year flood. The effect on the area flooded by the 100-year frequency storm is shown in the following table:

Reach[a/]	Area Inundated 100-Year Frequency Storm Without Project (Ac.)	With Project (Ac.)
VIII	1,159	372
IX	435	316
Total	1,594	688

a/ Reaches XV (1,200 acres), XVI (1,300 acres), and XVII (200 acres) were not evaluated. Reach XVII benefited area as shown on the project map has been eliminated by lack of economic feasibility of Subwatershed No. 4.

Benefits would occur to an area beyond the 100-year flood plain and is shown on the project map as benefit area. Stream channels in this watershed are very large and contain most floods thus preventing extensive overflow on the Pleistocene developed flood plain. This area would be covered by infrequent floods such as the 1967 flood. The 1967 flood was estimated to be in excess of the 100-year frequency flood at Ness City and limited flooding did occur within the city limits. Urban damages would be reduced during this type of event; however, these benefits were not considered in evaluation of the project.

Average annual flood damages will be reduced by 36 percent in this watershed. A 12 percent reduction will result from land treatment applied to this watershed and upstream watersheds; nine percent from structural measures in this watershed; and 15 percent from structural measures in upstream watersheds. The watershed program will benefit all or parts of 17 farms on the evaluated flood plain. In addition, the project will benefit directly or indirectly all of the 3,057 inhabitants of the watershed (including 39 farms with 3,200 acres of non-evaluated flood plains having significant damage only with floods approaching or exceeding the 100-year frequency storm) and 166 farms (47,767 acres) and 22,235 urban, suburban, or small town inhabitants downstream in the Wet Walnut Creek flood plain.

The proposed project would have reduced damage from the September 1959 flood by 64 percent. The total area flooded would have been reduced from 1,424 acres to 374 acres.

The project will increase the level of flood protection of the planned local protection works at Great Bend. The requirements of the National Flood Insurance Act of 1968 and the Flood Diaster Protection Act of 1973 will serve to regulate further development of designated flood prone areas. Ness City was designated as flood prone because of flooding in 1967. No residential and little if any flooding is anticipated during the 100-year frequency flood. The city had opportunity to appeal their flood prone designation but requested eligibility under the Emergency Flood Insurance Program and have subsidized insurance available to residents.

Normal release of retarded floodwater will result in increased ground water recharge. Principal spillways are planned to sustain bankfull conditions in the tributary and

mainstem channels. More than one-half of flows that would normally pass a given point over a 2- to 3-day period will be detained within channel banks for 20 to 30 days. This increase in channel flow duration will increase recharge through the channel walls.[17] Reduced flood plain inundation does not reduce the net recharge increase since a negligible amount of natural recharge takes place through flood plain soils and subsoils. Three thousand three hundred acre feet of mainstem recharge and 1,700 acre feet of tributary recharge will occur annually. These same works will increase evapotranspiration losses 2,200 acre feet annually.

Land use and cropping patterns on the flood plain are not expected to change greatly. The land treatment program should result in more efficient use of land and water and, thus, increase farm income.

Average annual soil loss in this watershed will be reduced from 3.7 to 2.6 tons/acre. Changes in soil losses by land use will be: cropland 4.9 to 3.3 tons/acre; rangeland 1.5 to 1.2 tons/acre; forestland and miscellaneous no change. The project will reduce severe scour.

The combined effects of the four watershed projects will reduce the total average annual sediment yield to the Arkansas River from an estimated 170,000 tons to 86,400 tons. The average annual sediment yield from this watershed to Wet Walnut Creek will be reduced by 32,000 tons. However, the average annual sediment yield from this watershed to the Arkansas River will be reduced by 25,200 tons.

The water quality standards for Kansas streams such as Wet Walnut Creek are already being met. They will still be met following completion of the watershed project.[18] The major impact upon quality of water in Wet Walnut Creek and its tributaries will be the reduction in sediment load.

Other effects of the watershed project on the quality of streamflow will be minimal and localized, although a lack of data concerning the effects of completed watershed projects on streamflow quality prevents any detailed predictions. It is likely that some reduction will occur in organic waste and nutrient levels.

Fish and Wildlife

Base flow in main streams will be increased as will the flow in all streams below structures. Prolonged releases and seepage

from the reservoirs are expected to provide additions to low flows of sufficient magnitude or duration to change some stream classifications: 10 miles of ephemeral stream to intermittent. During some periods reservoir levels will be below principal spillway inlets. Natural stream flow will be passed through the dam during drought periods as required to meet downstream water rights.

Some soil erosion and air and water pollution will occur during reservoir construction. These effects will be minimized.

A reduction in mortality to species inhabiting the flood plain below structures will occur due to reduced flooding. Rather than increasing population levels, this will probably tend to stabilize populations in that area.

One hundred eighty-five acres of cropland and 595 acres of rangeland in sediment and recreation storage pools will be lost to agricultural and terrestrial wildlife habitat use. Periodic flooding of 2,810 acres of retarding and detention areas will interrupt and reduce agricultural and wildlife uses. In addition, construction of dams and spillways on 338 acres of cropland and 205 acres of rangeland will largely displace these uses; however, revegetation will return most of the land to wildlife habitat. Ninety-five acres of agricultural land associated with the recreational development areas will be available for use as managed terrestrial wildlife areas.

Measures to enhance fish and wildlife habitat (fencing and seeding areas to grasses and legumes, additional tree and shrub plantings, and seeding pool areas to quick cover crops) will increase fish and wildlife habitat. Installation of land treatment measures will improve terrestrial wildlife habitat by increasing habitat diversity.

Project measures will create 780 surface acres of habitat for aquatic species and migratory waterfowl. They will improve the Wet Walnut Creek stream fishery.

Impoundments will inundate 8 miles of ephemeral stream.

The proposed project should have no impact on endangered or threatened species other than to increase the possible

number of resting places available to the whooping crane, a possible transient resident in the area.[12]

Recreation

Construction of the multipurpose reservoir will provide 200 acres for recreational use and is expected to draw visitors from throughout the area of influence. Fifty percent of the visitors will come from outside the region. While the lake and recreational facilities will be used throughout the year, 60 percent of the recreational visits will occur between May 15 and September 15. The daily design capacity for the site will be 173 for sightseeing, 3 for boating, 55 for fishing, 51 for picnicking, and 38 for camping. Hunting, fishing, picnicking, random and primitive camping, sightseeing, and other recreational activities will be available. An estimated 30,000 annual recreational visits are expected.

The multipurpose reservoir will provide fishing waters during drought periods and will maintain a stable fish population for use by watershed residents during these periods.

Water quality in the multipurpose reservoir is expected to be adequate for the intended use and to meet state water quality criteria.[18]

Archeological, Historic, and Scientific

Project measures will have no effect on any known historical or archeological sites. The State Historic Preservation Officer and the National Park Service will be notified immediately of any archeological sites discovered during construction.

Economic and Social

The works of improvement will have a positive effect on the area economy. Construction of the P.L. 566 structures will provide 91 man-years of new employment over a 10-year period. Operation, maintenance, and replacement will provide 1.6 man-years of employment annually. These employment opportunities will primarily benefit low and moderate income groups of the area.

There will be a positive effect on the quality of living for many watershed residents resulting from increased capital

made available by reduced floodwater damages and more intensive use of property used in agricultural production. In addition, the general public, especially watershed residents, will benefit from better roads as a result of the reduced maintenance and repairs of the road system.

Relocation may adversely affect the quality of living for 6 persons on 3 farms that will be eligible for relocation assistance. It is estimated that 322 acres of these farms will be affected. None of the farmsteads and dwellings will be inundated or otherwise involved. Most of the residents are near retirement age and may elect to accept the reduction in sizes of the farms instead of relocating. Decreasing the sizes will decrease agricultural income for farm operators, an adverse effect on the quality of life for these persons.

The project offers a sound basis for rural development. Farm operations in areas where a high degree of flood protection is offered have a better chance of survival. Thus a reversal in the trend of declining numbers of farms could be more likely with the project.

Secondary benefits will result from transporting, processing, and marketing greater amounts of agricultural commodities produced as a result of reduced crop losses. Increased farm incomes will mean increased consumer expenditures for farm equipment and material to local retailers and wholesalers. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation. An increase in job opportunities and the economic benefits associated with additional commercial growth activities, particularly those which service the recreational areas, will accrue to the watershed and region.

In addition to the monetary benefits, there are other substantial intangible benefits which will result from the project. These include better living conditions, a sense of economic security, and the psychological security associated with the abatement of a fear of flooding.

The recreational developments will provide needed public open space areas in addition to serving recreational use needs.

Sediment pools of the floodwater retarding structures and detention dams will be of some benefit to agricultural operations by providing livestock water supply.

Traffic, noise, and litter around the recreational developments will increase. For nearby residents, the aesthetic value of the area will change with the addition of reservoirs and recreational facilities.

At the multipurpose structure 16 acres around the full pool shoreline will be exposed 20 percent of the time.

Other

The following land use changes are expected to occur during the installation period of the project:

Land Use	Present (acres)	End of Installation (acres)	Net Changes (acres)
Cropland	150,493	141,901	-8,592
Rangeland	72,023	78,458[a/]	+6,435
Forestland	4,000	4,075	+ 75
Other	2,052	4,134[b/]	+2,082
Total	228,568	228,568	

a/ Includes 640 acres hayland
b/ Includes +2,047 acres for wildlife and recreation

PROJECT BENEFITS

Average annual project benefits are $391,600. Of this, $1,500 will accrue from land treatment measures and $390,100 from structural measures. Individual items are shown in Table 5 and Table 6.

Average annual floodwater damage reduction benefits with the project installed will total $3,300. Benefits from reduced floodwater damage to crops and pasture will average $2,500 annually and account for 76 percent of the total floodwater damage reduction benefits. Reduced flooding will achieve benefits of $400 to other agricultural properties such as

stored feed, fences, buildings, and other farm facilities. Annual average benefits of $400 to roads and bridges will result.

Benefits from reduced scour damage to flood plain land and channel deposition will average $600 annually accounting for about 14 percent of the total damage reduction benefits. Indirect average annual benefits, such as less interruption of travel for mail, school buses, and milk routes, are $400.

The reduction of the flood hazard will make possible annual benefits averaging $26,200 from more intensive use of land through improved crop rotations and use of fertilizer.

Multipurpose Structure No. 34 will produce annual recreation benefits of $60,000 from boating, fishing, sightseeing, camping, hunting, picnicking, and swimming. A value of $2.00 per recreation day is used in the evaluation.

Local net secondary benefits will average $86,300 annually. Secondary benefits from a national viewpoint were not considered in the economic evaluation.

The following off-project benefits will occur annually: $72,400 in Subwatershed No. 2; $32,300 in Subwatershed No. 1; and $111,400 between Subwatershed No. 1 and the Arkansas River.

Incidental benefits for beneficial use of stored water will be $2,500. Incidental ground water recharge benefits will be $296,600. Incidental benefits were not claimed toward project justification.

COMPARISON OF BENEFITS AND COSTS

Average annual cost of structural measures, including installation, operation, maintenance, and administration is $297,400. When the project is completely installed, the structural measures are expected to produce average annual benefits (excluding local secondary benefits) of $303,800. The benefit-cost ratio without including local secondary benefits is 1.02 to 1. With local secondary benefits of $86,300 included, the project benefit-cost ratio is 1.31 to 1 (see Table 6).

PROJECT INSTALLATION

Works of improvement to be installed by the district are proposed to be completed within a ten-year period following the adoption of the watershed plan. This schedule is contingent upon availability of federal funds provided under authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83d Congress; 68 Stat. 666) as amended.

Land treatment measures will be installed by individual landowners and groups of landowners, in cooperation with the Agricultural Stabilization and Conservation Service, Extension Forestry, conservation districts, and the watershed district. Technical assistance for land treatment installation will be provided by Extension Forestry, Soil Conservation Service, and the Kansas Forestry, Fish and Game Commission.

Land treatment measures include nine detention dams that are also a part of the works of improvement in the General Plan of the watershed district.[25] Approval of the General Plan has been obtained in accordance with section 24-1213 and 24-1214 of the Kansas Watershed District Act, as amended, from the Chief Engineer of the Division of Water Resources, State Board of Agriculture. The General Plan has been adopted by Wet Walnut Creek Watershed Joint District No. 58. This process, along with requirements of the Chief Engineer, are assurances that the nine detention dams will be installed essentially as planned. Technical assistance for the detention dams will be provided by the Service and the watershed district.

The Extension Service will assist in carrying out the educational phase of the program through the preparation of general information in cooperation with the conservation district. The Farmers Home Administration's Soil and Water Loan Program will be available to eligible farmers in the area. The County Agricultural Stabilization and Conservation Committees will cooperate with governing bodies of the conservation districts to accelerate assistance for those practices which will accomplish the conservation objectives.

The watershed district will obtain all land rights, including legal services, needed for installation of the 11 floodwater retarding structures. P.L. 566 funds will pay 50 percent, the watershed district will pay 25 percent and

the Kansas Forestry, Fish and Game Commission will pay 25 percent of the cost of land acquisition for the multipurpose structure and associated recreational facilities. The watershed district will obtain 100 percent of the remaining land rights required for the multipurpose structure. The district and the Kansas Forestry, Fish and Game Commission will share equally the legal fees associated with land acquisition for the multipurpose structure. The watershed district has the power of eminent domain to obtain land rights for public improvements and has agreed to use such authority when needed.

The watershed district will make arrangements for abandonment, moving, or modification of roads, pipelines, communication lines, or other public utilities.

Land rights will be secured in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Land rights maps for each structure have been furnished to the sponsors.

The watershed district, as a part of their project administration, will provide written notice, application forms, and advisory services to each displaced person or farm operation; assist in filing applications; review and take action on applications for relocation assistance and displacement grievances; and make relocation payments. The Service will assist the district in carrying out its responsibility.

Decent, safe, and sanitary replacement housing, if needed, will be made available prior to the construction of measures causing such displacements. All displaced persons will be given at least 90 days advance notice to vacate.

Engineering for the 11 floodwater retarding structures and the multipurpose structure will be provided by the Service. Engineering for recreational facilities will be provided in part by the Kansas Forestry, Fish and Game Commission through its regularly employed staff and in part by the Service in the form of on-site planning and standard designs. Technical assistance will be provided by the Kansas Forestry, Fish and Game Commission for the installation of wildlife measures.

The watershed district will contract for construction of the 11 floodwater retarding structures and the multipurpose

structure. Recreational facilities will be installed by the Kansas Forestry, Fish and Game Commission with materials furnished by the Service.

Construction inspection of the 11 floodwater retarding structures and the multipurpose structure will be provided by the Service. Sponsors will make contributions toward construction inspection in accordance with their needs. The Service and the Kansas Forestry, Fish and Game Commission will share the construction inspection of the recreational facilities as needed.

Construction can be started when necessary land treatment has been completed, necessary land rights have been obtained, P.L. 566 funds are available, and sponsoring organizations have complied with state laws relating to approval of construction plans.

Kansas Forestry, Fish and Game Commission participation in sponsorship of the multipurpose reservoir is contingent upon funding approval by the state legislature.

FINANCING PROJECT INSTALLATION

Land treatment measures will be financed by landowners and operators with partial cost sharing through the watershed district and/or state and federal programs in effect at the time of installation. Technical assistance will be provided by the Service using P.L. 46 funds and supplemented by accelerated assistance using P.L. 566 funds.

Installation costs of forestry land treatment and fire control measures will be borne by individual landowners, rural fire districts, and other federal programs. The cost of accelerated technical forestry assistance will be borne by P.L. 566 and the Kansas State and Extension Forester. Technical assistance for the fire control measures will be financed by the Kansas State and Extension Forester through the Fire Control Program.

Wet Walnut Creek Watershed Joint District No. 58 and the Kansas Forestry, Fish and Game Commission have the necessary authority and power to finance and carry out watershed improvements. These powers include the right to accept contributions, levy taxes, make assessments against land specially benefited issue bonds, and exercise the right to eminent domain.

Expenses of organizing the watershed district have been paid and current general expenses are being met by an annual ad valorem tax levy.

All local costs to be financed by the sponsors will be paid from funds currently on hand and budgeted for the purpose, funds that will be collected through taxes before construction takes place, or through the issuance of general obligation bonds.

Relocation assistance advisory services costs will be financed by the watershed district through a general tax levy.

P.L. 566 funds for construction and land rights will be provided to the local sponsoring organizations through project agreements executed with the Soil Conservation Service.

Prior to entering into agreements that obligate funds of the Service, the Wet Walnut Creek Watershed Joint District No. 58 and the Kansas Forestry, Fish and Game Commission will have a financial management system for control, accountability, and disclosure of P.L. 566 funds received, and for control and accountability for property and other assets purchased with P.L. 566 funds.

Program income earned during the grant period will be reported on the sponsor's request for advance or reimbursement from the Service.

Federal technical assistance, engineering services, project administration, and funds for construction are contingent upon appropriations for these purposes.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners and operators of farms on which the measures are installed under agreements with the conservation district. Conservation district representatives will make periodic inspections of land treatment measures to encourage landowners to perform needed maintenance.

The watershed district is responsible for operation and maintenance of the nine detention dams. The district will

enter into agreements with the landowners who will perform maintenance as needed.

Technical assistance to landowners and rural fire districts for operating and maintaining forestry and fire control measures beyond the installation period will be provided by the Kansas State and Extension Forester in cooperation with the Forest Service under going programs.

Agreements providing for operation and maintenance of structural measures and recreational facilities will be executed by the local sponsoring organizations before federal construction funds are made available.

The 11 floodwater retarding structures and the dam for the multipurpose structures will be operated and maintained by the watershed district. The estimated average annual costs are $9,100. Maintenance will be accomplished through hired or contributed labor and equipment, and funds will be obtained from an annual tax levy.

Recreational facilities and fish and wildlife habitat measures for the multipurpose reservoir will be operated, maintained, and replaced by the Kansas Forestry, Fish and Game Commission. Estimated annual cost is $9,900, of which $900 is for recreational facilities replacement. Useful life will vary for recreational facilities, but an average period of 20 years has been used to compute replacement costs. Funds will be obtained from Kansas Forestry, Fish and Game Commission revenues.

The Wet Walnut Creek Watershed district will assume the responsibility for passing natural stream flow and managing low-flow releases from the eleven floodwater retarding structures. Making releases and passing natural stream flow through the multipurpose reservoir will be the responsibility of the Kansas Forestry, Fish and Game Commission. The recreational pool is normally expected to be operated between elevations 2,192.3 and 2,198.5.

A vegetative measure (associated with structural measures) establishment period is granted. During this period the State Conservationist may approve P.L. 566 cost sharing for additional work that is required to obtain adequate vegetative cover. This

period is to terminate when adequate vegetative cover is obtained or two growing seasons have elapsed after initial installation of vegetative work, whichever occurs first. Operation and maintenance responsibility rests with the sponsors during the establishment period as it does during the remainder of the project life.

Maintenance work for structural measures will be carried out when needed. Kinds of maintenance expected rather frequently are repairs to fences, clearing of debris, etc. Repairs to major construction items such as dams and spillways are expected very infrequently. Technical assistance available through the Soil Conservation Service will be utilized.

Prescribed tree and shrub plantings will be maintained at a 75 percent survival rate for the first five years, and thereafter managed to allow for desirable natural growth and reproduction during the life of the project. Mowing, haying, burning, and livestock grazing will be permitted only when deemed compatible with wildlife uses.

All structural measures will be inspected annually, after unusually severe storms, and after any other unusual condition that might adversely affect their operation, maintenance, or safety. The Soil Conservation Service and local representatives responsible for operation and maintenance will make annual inspections jointly for a three-year period following completion of construction. Thereafter, annual inspection will be made for the life of the structures by the sponsors.

Items of inspection will include, but not be limited to: the principal spillway and its appurtenances, emergency spillway, earth fill, vegetative cover of the earth fill and emergency spillway, fences installed as part of the structural measures, wildlife measures, and recreational facilities. Records of inspection will be maintained by the watershed district. Provisions will be made for access to inspect the structures at any time.

Sediment and beneficial use pools will be checked regularly during spring and summer months and measures taken to control mosquito breeding.

Where public access for recreation is permitted at any site, the sponsoring local organizations will require or provide sanitary facilities necessary to meet State Department of Health and Environment Standards to insure health and safety.

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with P.L. 566 financial assistance.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Wet Walnut Creek Subwatershed No. 3, Kansas

Installation Cost Item	Unit	Number Non-Fed. Land	Estimated Cost (dollars)[a] P.L. 566 Funds Nonfederal Land SCS[c]	FS[c]	Total	Other Nonfederal Land SCS[c]	FS[c]	Total	Total
LAND TREATMENT									
Land Areas[b]	Acres								
Cropland	to be	52,000				1,065,000		1,065,000	1,065,000
Rangeland	treated	30,000				561,700		561,700	561,700
Forestland		380					10,600	10,600	10,600
Individual Practices such as -									
Fire control		76,000					17,000	17,000	17,000
Technical Assistance			77,900	11,400	89,300	259,800	7,600[d]	267,400	356,700
TOTAL LAND TREATMENT			77,900	11,400	89,300	1,886,500	35,200	1,921,700	2,011,000
STRUCTURAL MEASURES									
Construction									
Floodwater Retarding Structures	No.	11	2,397,500		2,397,500				2,397,500
Multipurpose Structure	No.	1	169,000		169,000	22,900		22,900	191,900
Recreational Facilities	No.	1	16,300		16,300	16,300		16,300	32,600
Subtotal - Construction			2,582,800		2,582,800	39,200		39,200	2,622,000
Engineering Services			364,800		364,800	2,400		2,400	367,200
Relocation Payments			6,900		6,900	4,100		4,100	11,000
Project Administration									
Construction Inspection			746,400		746,400	2,500		2,500	748,900
Other			257,400		257,400	91,400		91,400	348,800
Relocation Assistance Advisory Services						500		500	500
Subtotal - Administration			1,003,800		1,003,800	94,400		94,400	1,098,200
Other Costs									
Land Rights			20,000		20,000	415,200		415,200	435,200
TOTAL STRUCTURAL MEASURES			3,978,300		3,978,300	555,300		555,300	4,533,600
TOTAL PROJECT			4,056,200	11,400	4,067,600	2,441,800	35,200	2,477,000	6,544,600

a/ Price base 1974
b/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.
c/ Federal agency responsible for assisting in installation of works of improvement.
d/ Includes $5,000 contributed through going programs.

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TABLE 1A - STATUS OF SUBWATERSHED WORKS OF IMPROVEMENT
(at Time of Work Plan Preparation)

Wet Walnut Creek Subwatershed No. 3, Kansas

Measures	Unit	Applied to Date	Total Cost (dollars)[a/]
Land Treatment			
Soil Conservation Service			
Conservation cropping system	Acre	100,000	1,473,400
Crop residue management	Acre	109,000	481,900
Contour farming	Acre	126,746	560,200
Proper grazing use	Acre	30,000	44,200
Range seeding	Acre	8,280	122,000
Grassed waterway	Acre	841	136,300
Diversion	Feet	93,836	18,300
Terrace	Mile	2,128	627,200
Farm pond	Number	239	281,900
Irrigation systems	Acre	2,240	528,900
Grade stabilization structure	Number	2	5,300
Floodwater retarding structure	Number	2	10,600
Subtotal - SCS			4,290,200
Forest Service			
Tree and shrub planting	Acre	1,500	48,700
Fire Control	Acre	14,500[b/]	20,900
Subtotal - FS			69,600
Total			4,359,800

a/ Price base 1974.
b/ These acres are included in Table 1 as needing further treatment.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

(Dollars)[a]

Wet Walnut Creek Subwatershed No. 3, Kansas

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construction	Engineering	Land Rights	Relocation Payments	Total P.L. 566	Construction	Engineering	Land Rights	Relocation Payments	Total Other	
Floodwater Retarding Structures											
No. 35	136,000	19,500			155,500			15,600		15,600	171,100
No. 36	205,200	30,900		3,100	239,200			45,000	1,900	46,900	286,100
No. 37	138,400	13,500			151,900			27,200[b]		27,200	179,100
No. 38	225,600	31,400			257,000			51,800[c]		51,800	308,800
No. 39	152,200	21,800		1,900	175,900			40,700	1,100	41,800	217,700
No. 40	75,900	11,100			87,000			15,900		15,900	102,900
No. 41	267,600	39,200			306,800			51,100[d]		51,100	357,900
No. 42	244,100	36,800			280,900			22,500[e]		22,500	303,400
No. 43	266,200	36,500			302,700			32,400		32,400	335,100
No. 44	147,000	20,800			167,800			24,400		24,400	192,200
No. 45	539,300	75,000			614,300			64,400		64,400	678,700
Subtotal - FRS	2,397,500	336,500		5,000	2,739,000			391,000	3,000	394,000	3,133,000
Multipurpose Structure No. 34	169,000	27,500	12,000	1,900	210,400	22,900		16,200[f]	1,100	40,200	250,600
Recreational Facilities No. 34	16,300	800	8,000		25,100	16,300	2,400	8,000		26,700	51,800
Subtotal - MPS	185,300	28,300	20,000	1,900	235,500	39,200	2,400	24,200	1,100	66,900	302,400
Total	2,582,800	364,800	20,000	6,900	2,974,500	39,200	2,400	415,200	4,100	460,900	3,435,400
Project Administration					1,003,800					94,400	1,098,200
GRAND TOTAL	2,582,800	364,800	20,000	6,900	3,978,300	39,200	2,400	415,200	4,100	555,300	4,533,600

a/ Price base 1974.
b/ Includes $2,200 for road modification and $4,800 for bridge modification.
c/ Includes $1,400 for road modification.
d/ Includes $11,400 for road modification and $4,000 for bridge modification.
e/ Includes $1,600 for road modification and $1,000 for bridge modification.
f/ Includes $3,000 for legal fees and $1,200 for easements.

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY
(Dollars)[a]

Wet Walnut Creek Subwatershed No. 3, Kansas

Item	Cost Allocation			Cost Sharing					
	Purpose			P.L. 566			Other		
	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total
ll Floodwater Retarding Structures	3,133,000		3,133,000	2,739,000		2,739,000	394,000		394,000
Multipurpose Structure No. 34	170,700	79,900	250,600	168,600	41,800	210,400	2,100	38,100	40,200
Recreational Facilities		51,800	51,800		25,100	25,100		26,700	26,700
Total	3,303,700	131,700	3,435,400	2,907,600	66,900	2,974,500	396,100	64,800	460,900

a/ Price base 1974

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TABLE 2B - RECREATIONAL FACILITIES - ESTIMATED CONSTRUCTION COSTS

(Dollars)[a]

Wet Walnut Creek Subwatershed No. 3, Kansas

Item	Number	Estimated Unit Cost	Total Construction Cost
Road, gravel, 24' width	3,700 ft.	1.85/Ft.	6,800.00
Parking Area, gravel	20,000 sq. ft.	.075/Ft.	1,500.00
Fence, barbed, 4 wire steel posts	2.9 mi.	3000/Mi.	8,700.00
Corrugated metal pipe-24"	72 ft.	$14/Ft.	1,000.00
80 ft. boat ramp, concrete, 14' width	1	Lump Sum	2,000.00
Toilet, vault, concrete block	1	Lump Sum	2,500.00
Drinking water well	1	Lump Sum	3,000.00
Sun shades, wood	2	540	1,100.00
Picnic Tables, 7' wood	4	70	300.00
Grills, metal, waist high	4	50	200.00
Refuse barrels, metal	2	20	100.00
			27,200.00
	Add 20% contingency costs		5,400.00
Total			32,600.00

a/ Price base 1974 September 1975

TABLE 3 - STRUCTURE DATA
MULTIPURPOSE AND FLOODWATER RETARDING STRUCTURES

Wet Walnut Creek Subwatershed No. 3, Kansas

Item	Unit	Structure Number												
		34 MP	35	36	37	38	39	40	41	42	43	44	45	Total
Class of Structure		b	b	a	a	b	b	a	c	b	c	a	c	
Drainage Area	Sq. Mi.	4.90	5.40	18.80	10.10	18.60	16.80	5.60	18.47	10.93	9.06	14.60	43.80	177.06
Controlled	Sq. Mi.	-	-	-	-	-	-	-	10.93	-	-	-	-	
Curve No. (1-day)(AMC II)		73	74	74	72	73	73	75	73	72	74	71	70	
Tc	Hours	1.0	1.6	7.1	3.2	5.1	2.5	3.5	8.9	2.0	2.4	4.5	6.4	
Elevation Top of Dam	Feet	2,215.5	2,185.5	2,178.7	2,349.6	2,359.3	2,243.2	2,223.6	2,273.6	2,417.4	2,294.0	2,398.2	2,397.8	
Elevation Crest Emergency Spillway	Feet	2,210.5	2,180.3	2,173.7	2,343.2	2,353.8	2,237.2	2,218.6	2,264.5	2,408.6	2,285.2	2,393.2	2,385.6	
Elevation Crest Low Stage Inlet	Feet	2,198.5	2,170.8	2,159.6	2,327.3	2,335.2	2,224.0	2,208.0	2,246.6	2,393.6	2,270.5	2,377.2	2,366.8	
Maximum Height of Dam	Feet	45.3	26.1	32.4	34.0	39.3	30.8	26.3	42.6	36.1	34.0	37.9	48.6	
Volume of Fill	Cu. Yds.	179,000	124,400	193,600	112,000	259,700	142,200	57,500	310,700	127,600	331,100	150,200	631,200	2,619,200
Total Capacity	Ac. Ft.	1,204	956	3,179	1,595	3,016	2,751	928	2,866	1,699	2,009	1,884	5,980	28,067
Sediment Submerged	Ac. Ft.	68	124	311	189	278	278	119	296	180	145	164	654	2,806
Sediment Aerated	Ac. Ft.	-	3	10	5	10	9	3	9	6	4	7	23	89
Beneficial Use (Recreation)	Ac. Ft.	287	-	-	-	-	-	-	-	-	-	-	-	287
Retarding	Ac. Ft.	849	829	2,858	1,401	2,728	2,464	806	2,561	1,513	1,860	1,713	5,303	24,885
Surface Area														
Sediment pool	Acres	13	35	76	37	48	70	28	60	43	50	39	110	609
Beneficial Use Pool (Recreation)	Acres	40	-	-	-	-	-	-	-	-	-	-	-	40
Retarding Pool	Acres	111	144	376	159	255	344	142	264	171	258	170	470	2,864
Principal Spillway														
Rainfall Volume (areal)(1-day)	Inches	5.7	5.7	5.9	6.0	5.8	5.6	5.7	5.8	6.0	5.9	5.9	5.6	
Rainfall Volume (areal)(10-day)	Inches	9.0	9.0	9.7	9.7	9.6	8.8	8.9	9.7	9.8	9.6	9.6	9.4	
Runoff Volume (10-day)	Inches	3.65	3.38	3.46	3.80	3.25	2.82	3.65	3.24	3.60	4.17	2.94	2.25	
Capacity of Low Stage (Max.)	c.f.s.	24.5	27.6	98.2	51.8	105.7	95.3	27.5	128.2	64.2	33.6	64.7	229.4	
Frequency Operation - Emergency Spillway	% Chance	1	2	1	1	1	2	2	0.5	1	0.12	0.9	0.20	
Size of Conduit	Dim.	24"	24"	30"	24"	30"	30"	18"	36"	24"	30"	24"	42"	
Emergency Spillway														
Rainfall Volume (ESH)(areal)	Inches	7.5	7.6	5.9	7.4	6.8	7.0	4.9	10.2	7.2	10.3	5.95	8.0	
Runoff Volume (ESH)	Inches	4.36	4.39	3.10	4.17	3.76	3.90	2.36	6.81	4.21	7.02	2.86	4.26	
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	
Bottom Width	Feet	225	200	400	300	800	600	400	1,000	700	500	500	600	
Velocity of Flow (V_e)a/	Ft./Sec.	5.5	5.3	1.9	6.6	4.1	4.4	b/	7.6	5.6	6.7	4.4	6.3	
Slope of Exit Channel	Ft./Sec.	.034	.035	.040	.029	.033	.039	b/	.029	.031	.033	.040	.015	
Maximum Water Surface Elevation	Feet	2,212.3	2,182.5	2,174.0	2,346.1	2,355.7	2,239.5	b/	2,268.9	2,411.1	2,288.6	2,395.0	2,390.1	
Freeboard														
Rainfall Volume (FH)(areal)	Inches	13.4	13.6	9.90	13.3	12.2	12.5	7.40	25.5	12.9	25.7	10.0	20.1	
Runoff Volume (FH)	Inches	9.79	9.85	6.65	9.55	8.70	8.95	4.50	21.52	9.49	21.91	6.36	15.33	
Maximum Water Surface Elevation	Feet	2,215.5	2,185.5	2,177.6	2,349.6	2,359.3	2,243.2	2,221.3	2,273.6	2,413.8	2,294.0	2,398.2	2,397.8	
Capacity Equivalents														
Sediment Volume	Inches	0.26	0.44	0.32	0.36	0.29	0.32	0.41	0.31	0.32	0.31	0.22	0.29	
Retarding Volume	Inches	3.25	2.88	2.85	2.60	2.75	2.75	2.70	2.60	2.60	3.85	2.20	2.27	
Other	Inches	1.10	-	-	-	-	-	-	-	-	-	-	-	

a/ Maximum during passage of hydrograph

b/ Emergency spillway hydrograph is contained below crest of emergency spillway

September 1975

TABLE 4 - ANNUAL COST

Wet Walnut Creek Subwatershed No. 3, Kansas

(Dollars)[a/]

Evaluation Unit	Amortization of Installation Cost[b/]	Operation and Maintenance Costs	Total
11 Floodwater Retarding Structures, 1 Multipurpose Structure, and Recreational Facilities	211,000	19,000	230,000
Project Administration	67,400		67,400
GRAND TOTAL	278,400	19,000[c/]	297,400

a/ Price base 1974
b/ 100 years at 6 1/8 percent interest
c/ Includes$9,900 for operation, maintenance, and replacement for the recreational development.

September 1975

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Wet Walnut Creek Subwatershed No. 3, Kansas

(Dollars)a/

Item	Estimated Average Annual Damage		Total Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	7,000	4,500	2,500
Other Agricultural	1,000	600	400
Non-agricultural			
Road and Bridge	1,000	600	400
Subtotal	9,000	5,700	3,300
Sediment			
Channel Deposition	400	300	100
Erosion			
Flood Plain Scour	1,600	1,100	500
Indirect	1,100	700	400
TOTAL ON PROJECT	12,100	7,800	4,300
Floodwater			
Crop and Pasture	xxx	xxx	62,200
Other Agricultural	xxx	xxx	12,400
Non-agricultural			
Road and Bridge	xxx	xxx	5,800
Railroad	xxx	xxx	1,800
Urban	xxx	xxx	112,800
Subtotal			195,000
Sediment			
Channel Deposition	xxx	xxx	300
Erosion			
Flood Plain Scour	xxx	xxx	11,100
Indirect	xxx	xxx	9,700
TOTAL OFF PROJECT			216,100
TOTAL			220,400

a/ Price base: Agricultural = current normalized (WRC - October 1974); all other = 1974

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Wet Walnut Creek Subwatershed No. 3, Kansas

(Dollars)a/

Evaluation Unit	Average Annual Benefits a/				Total	Average Annual Costc/	Benefit Cost Ratio
	Damage Reductionb/	More Intensive Land Use	Recreation	Secondary			
11 Floodwater Retarding Structures and 1 Multi-purpose Floodwater Retarding and Recreational Structures	217,600	26,200	60,000	86,300	390,100	230,000	1.7:1
Project Administration						67,400	
GRAND TOTAL	217,600	26,200	60,000	86,300	390,100	297,400	1.3:1

a/ Price base: Agricultural current normalized (WRC - October 1974); all other 1974

b/ In addition it is estimated that land treatment measures will provide flood damage reduction benefits of $1,500 annually, including $700 for detention structures; P.L. 566 structures in Subwatershed No. 5 will provide $1,300 damage reduction

c/ From Table 4

December 1975

INVESTIGATIONS AND ANALYSIS

General

A joint study of the Upper Arkansas Basin by the Soil Conservation Service, Forest Service, Economic Research Service, and the Kansas Water Resources Board was started May 4, 1965. Wet Walnut Creek was studied as an example of large watershed potential in western Kansas. Stream and valley cross sections were surveyed by the Kansas Water Resources Board in five mainstem reaches from Heizer to Ness City and on three reaches of the North and South Forks above Ness City. Hydraulic computations were made by Cook, Flatt and Strobel, Consulting Engineers, Topeka, Kansas.

The Kansas Watershed Review Committee assigned a priority for planning July 31, 1967. A ground water recharge study was started in the Wet Walnut Basin as a cooperative venture of the Kansas Water Resources Board, the U.S. Geological Survey, and the Wet Walnut Creek Watershed District during the summer of 1968. The State Conservation Commission negotiated and funded contracts for structure site topographic maps of the Public Law 566 sites. Sites in the east half of the watershed district were surveyed by Evans, Bierly, and Hutchison, Consulting Engineers, Great Bend, Kansas; and sites in the west half of the watershed district were surveyed by George McKee, Jr., Consulting Engineer of Colby, Kansas. All other engineering, geologic, hydrologic, and economic investigations were conducted by the Soil Conservation Service.

A forestry work plan was developed by the State Extension Forester, Kansas State University, Manhattan, Kansas, and the Forest Service, U.S.D.A. Information for this plan was gathered from aerial photography of the watershed and a field examination of hydrologic conditions of woodlands. Estimates were made of land treatment measures needed to improve hydrologic conditions; these estimates were included in this work plan.[15/]

A letter report[10/] covering fish and wildlife resources and recommending measures to offset losses and enhance wildlife habitat was supplied by the Fish and Wildlife Service, U.S. Department of the Interior. The Kansas Forestry, Fish and Game Commission concurred with this report.

The Kansas Water Resources Board and State Conservation Commission provided assistance in drafting the watershed plans and environmental impact statement.

Hydrology and Hydraulics

The five Wet Walnut watersheds were treated as a hydrologic unit and broken down into 21 reaches. Each reach was evaluated for its present soil cover condition and for its future condition with planned land treatment and cover measures.

A standard procedure[19/] was used to find the relationship between rainfall and runoff with special consideration given to flat pot-holed areas and areas treated with level terraces. A factor of 2.5 was used to convert the annual flood plotting positions to partial duration plotting positions. The relationship between rainfall frequency and runoff volume was calculated for the actual range of hydrologic curve numbers.

Field surveys of the valley and road and bridge cross sections were made. Sufficient readings were taken to define the topography along each section, to locate all crop boundaries and changes in roughness, to locate all roads, fences, and other objects along the sections, and to define the shape of the channel in detail. The types of road surfaces and bridges were indicated on each road cross section.

The step method was used in defining the hydraulics of the flood plain. A range of discharges from below nondamage flow to above 100-year flood frequency was considered. Flood plain profiles were plotted showing the channel bottom, bank line, and at least five discharges. A semi-controlled, screened aerial mosaic map of the flood plain was developed for each reach.

The relationship between discharge and area of flood plain inundation was based on 73 valley and channel cross sections in eight detailed evaluation reaches. These cross sections were vertically related to mean sea level, and horizontally related by using aerial photographs. The width of flooding at each cross section and the distance between cross sections were used to compute the area flooded in each reach by depth increments. These area data were then combined to determine totals for each evaluated reach.

Similarly, road and bridge cross sections were used to compute lengths of roads inundated by various flood depths.

Frequency discharge relationships were developed for each reach using the SCS TR-20 computer program with service provided by the Central Technical Unit, Hyattsville, Maryland. Four uniform storms were routed to define discharge frequency curves for present conditions, future conditions with land treatment, future conditions with land treatment and various percentages of control by structures, and future conditions with land treatment and the proposed system of structures. These routings gave the discharge frequency relationship for each evaluation reach under present conditions and for various levels of control including that offered by the proposed plan. Routings were developed for historical storms, September 1959 and May-June 1967, and high-water marks were plotted on water surface profiles and peaks determined.

Release rates for floodwater retarding structures were selected according to downstream channel capacities, routing losses, and desired reservoir drawdown times. Single-stage release rates for all structures are shown in Table 3 (see "Capacity of Low Stage (Max.)"). Combined maximum release rates will not exceed channel capacities.

Floodwater storage volumes were determined using mass routing procedures for storm durations of up to 10 days. Storms used in this procedure were taken from U.S. Weather Bureau Technical Paper No. 40.[20] The volumes needed for floodwater storage were computed using 25-, 50-, or 100-year frequency storms, depending on the structure hazard class. Floodwater storages were selected to fit site conditions, with minimum volumes computed in accordance with the National Engineering Handbook.[19]

Emergency spillway requirements were found by routing the storms according to SCS Engineering Memorandum No. 27. Computer services were provided by SCS at Lincoln, Nebraska, and Fort Worth, Texas. Emergency spillways will exceed minimum criteria set by the State of Kansas.

For the design of the recreation site, trial and error solutions of the water budget equation by computer program, using average values over each drought period, gave the

expected reservoir level-frequency relationship. Yields used were minimum cfs per square mile for a range of time periods and drought frequency.[21/] Net evaporation values[22/] were also included in the computations. Evaporation and seepage losses were applied against the average reservoir surface area for each period under consideration. Mean annual runoff at each of the four sites was also computed by relating to channel geometry with assistance from the U.S. Geological Survey.[30/]

Engineering

Topographic maps of the sites for floodwater retarding structures and multipurpose structure were made using a photogrammetric plotter and field surveys. Aerial photographs were taken from approximately 4,800 feet, and topographic maps were made using a four foot contour interval. Accuracy of plotter work was verified by field surveys of centerline profiles. Using the topographic maps, storage capacities were measured and stage-storage curves were developed. Embankment quantities were calculated from centerline profiles.

An inventory of all man-made features, such as farm buildings, roads, bridges, existing and abandoned oil wells, pipelines, power lines, etc., was made and those affected by structures were located on the topographic maps.

Structure Design and Cost Estimates: Structures were planned with single-stage principal spillways and average release rates of 3.5 csm. Elevations of emergency spillway crests were selected to provide at least a 25-year detention storage.

Storage will be provided for a 100-year accumulation of sediment. The elevations of principal spillway crests of floodwater retarding structures will be at the 100-year sediment accumulation levels. The inlets of multipurpose structures are planned at the elevation that will store the 100-year sediment accumulations and provide water for recreation.

The freeboard hydrograph was routed through all structures with the maximum elevations at or below the tops of the dams.

Drainage areas for all sites were delineated and measured on USGS 7 $\frac{1}{2}$ minute quadrangle maps and photographs.

Individual structure cost data are presented in Table 2, and the total cost of all proposed structures is shown in Table 1.

Unit costs, reflecting current bid prices for embankment, principal spillways, riprap, fencing, drains, seeding, clearing, etc., were used to determine the total construction cost of each structure. Contingencies were calculated at 12 percent of the engineer's estimate. Installation services costs were calculated as a percentage of construction cost.

Geology

Site 34 was among ten sites in Subwatershed Nos. 1 through 5 selected by the Kansas Forestry, Fish and Game Commission in 1970 as having a potential for development as fishing lakes. The SCS analyzed the water-holding characteristics of these sites. Infiltration tests were run at all sites. Field determinations of seepage losses at constructed sites in Cimarron Watershed were made and compared with the infiltration tests.

A ground water study was conducted by the SCS from May 25 to July 15, 1967. The results of this study were incorporated into a more intensive study by the USGS for Rush County and summarized in Bulletin No. 17 of the Kansas Water Resources Board.[17]

The preceding two studies were used by SCS to make an algebraic account of the present without and future with project average annual water budget for the Wet Walnut Basin. The basin water budget was compiled by subwatersheds.

The Carlile Shale underlies 11 of the 12 proposed floodwater retarding structures. The depths of alluvium in the foundations range from two to greater than 20 feet. At three sites, rock must be excavated for emergency spillways. This rock is part of the Niobrara Chalk.

The Carlile Shale is comprised of three members. In ascending order these are: The Fairport shale, the Blue Hill

shale, and the Codell sandstone. The Niobrara Chalk is comprised of the Fort Hays limestone and Smoky Hill chalk members. Massive chalk beds (up to six feet thick) in the Fort Hays member pose the largest excavation problem.

All 12 sites were surface inspected. Limited drilling investigations were made on Site Nos. 36, 40, 41, and 45. All sites appear favorable for construction.

Sediment storage was based on existing reservoir sedimentation surveys. A delivery ratio of five percent was used for determining sediment yield from Subwatershed No. 3 to the Arkansas River.

Economic Investigations

Seven reaches representing 57 percent of the flood plain were evaluated in detail. The additional area was evaluated as related to these reaches. Five subwatersheds were evaluated as a unit then divided into individual reaches. Twelve of the 21 reaches had significant flood damage.

The frequency method[23/] was used to find average annual floodwater damages. Data on floodwater damages were collected by personal contacts with farm operators, township and county officials, and local agricultural technicians. Interviews were obtained from at least 46 percent of the landowners and operators of the flood plain area in each evaluation reach; the maximum interview coverage in any one reach was 65 percent. The storms of September 1959 and July 1958 were discussed.

Damages that occurred under present land treatment conditions were computed in each evaluation reach. Damage estimates were made for future land treatment conditions, future land treatment conditions with varying percentages of control by floodwater retarding structures, and future land treatment conditions with the proposed plan. Where more intensive use of land would be possible, benefits were computed under these same conditions. More intensive use was computed on those acres lying within the flood plain delineated by 2.84-year and the 10-year frequency floods.

A composite acre of flood plain use was constructed by measuring the percent of each land use shown on valley cross

sections. Average crop yields, adjusted to flood-free conditions by the judgment of farm operators and agricultural technicians, were projected to reflect future conditions without the project. Different composite acres and crop yields, which would be possible under more intensive land use, were similarly obtained.

The percent loss from each crop on the composite acre was estimated according to depth, duration, and month of flooding. The damage to the composite acre was weighted using the lower values of crop yields from the scoured areas. The percent loss was used to determine rates of damage on the composite acre (adjusted normalized prices), using the percent of the year's excessive storms occurring in each month,[24/] and the weighted value of the composite acre multiplied by total acreage inundated by selected discharges. A curve showing monetary damage versus flood discharge was developed to provide a cost estimate for each storm in the 100-year flood series. A weighted value (current normalized value) was developed and damages updated by a factor.

Interviews were used to determine other agricultural damages from the September 1959 and July 1958 storms. These included loss of livestock, damage to private roads, dikes, and fences, and removal of debris. From rainfall records and high water marks, the discharge of these storms was determined for each evaluation reach. From these data a dollar damage versus discharge curve was developed and applied to the 100-year flood frequency series. These values were updated to current prices.

Road and bridge damages were based on repair or replacement costs obtained from county engineers. Damages to various types of road surfaces were computed as the dollar damage per foot by depth of inundation. Damages to individual bridges were estimated for a range of discharges. Road and bridge damages were then combined in each evaluation reach and dollar damage versus discharge curves were plotted. These curves were then applied to the 100-year flood frequency series. The values were updated using the Engineering News Record Construction Cost Index.

Flood plain scour damages were derived from geologic field data. The number of acres damaged, the severity of

damage, and the estimated period and degree of recovery were considered, with and without the proposed project. The economic evaluation was based on the net value of the cropland composite acre. The changes in net income due to scour damage were discounted at an eight percent interest rate.

Indirect damages include such items as food spoilage from electric power failure; slower rate of weight gain of livestock and extra expense caused by feeding interruption (even though livestock were not in the flood); and additional distances driven by rural mail carriers, school buses, and farmers because of flooded roads. Indirect damages were computed at 10 percent of the agricultural damages and 15 percent of the nonagricultural damages.

Recharge benefits were computed as the increased net value from dryland cropland to irrigated cropland for that number of acres for which water will become available. This value was reduced for increased floodwater damage and discounted for a 10-year lag in accrual.

The damage reduction benefits occurring downstream from Subwatershed No. 1 are fair share benefits accruing to the project from the Great Bend area. This includes 13,100 acres of Wet Walnut flood plain below the watershed and 2,200 acres of flood plain common with the Arkansas River.

Increased flood damages from reduced channel capacity from sediment deposits were computed.

Recreational benefits were determined using procedures outlined in the Economic Guide, the Lincoln E&WP Technical Letter Recreation No. 5 (April 5, 1965), and Lincoln E&WP Technical Letter Recreation No. 6 (April 5, 1966). The watershed was computed to have a population of 2,300 people.

Within a 50-mile radius of the watershed there is a population of more than 128,200 people. Consultation with the staff of the Kansas Forestry, Fish and Game Commission and the Kansas Park Authority indicated that the demand for water-based recreation, such as that which would be offered at Site No. 34, would exceed 30,000 annual visitor days.

An estimated 60 percent of the total use will occur from May 15 to September 15 and 65 percent of the visits will occur

on a weekend day. By limiting parking area, recreational facilities were designed to limit use to 320 visits per weekend day. Some additional parking space is provided to accommodate vehicles on unmarked gravel parking lots. Other facilities were designed to adequately provide for visitor needs. A current value of $2.00 per each visit was used.

Incidental recreational benefits were not evaluated. Regional secondary benefits were computed following procedures in the E&WP Technical Note--Watershed LI-7, February 5, 1973. Indirect benefits and benefits resulting from a change in consumptive patterns were not included in computing secondary benefits. The region is defined as five counties, Barton, Rush, Ness, Lane, and Scott.

All structures were individually evaluated. The relative contribution that structural control in each upstream sub-watershed made toward reduction of peak discharge was the basis for distribution of evaluation reach benefits.

Costs of land rights were based on the value of cropland and pasture as determined by the watershed directors. These values, slightly higher than the capitalized value of net production, were used for project evaluation. The values agreed on were $300/acre for upland cropland, $750/acre for bottom cropland, and $200/acre for pasture for the floodwater retarding sites. Land costs were based on 100 percent of value for the sediment pool areas, 75 percent of value for the structure and spillway areas, and 50 percent of value for the floodwater retarding areas. The productive capacity retained under future conditions was thereby considered. Full fair market value was used as the basis for the cost of all land purchased for the recreational development.

All monetary benefits were based on current normalized prices approved by the Water Resources Council. Construction costs were based on 1974 construction costs for Kansas P.L. 566 projects. Operation and maintenance costs were computed at 0.35 percent of construction costs for floodwater retarding structures; this percentage method was developed by the SCS and is based on the principle that the relative probability of need for major repairs decreases as the number of structures increases. Operation and maintenance costs for the recreational facilities were computed at the current cost of $0.30 per

visitor day. Replacement costs of these facilities were computed on the basis of a 20-year life. Federal and local costs for structural measures were amortized at 6 1/8 percent interest rate for a period of 100 years.

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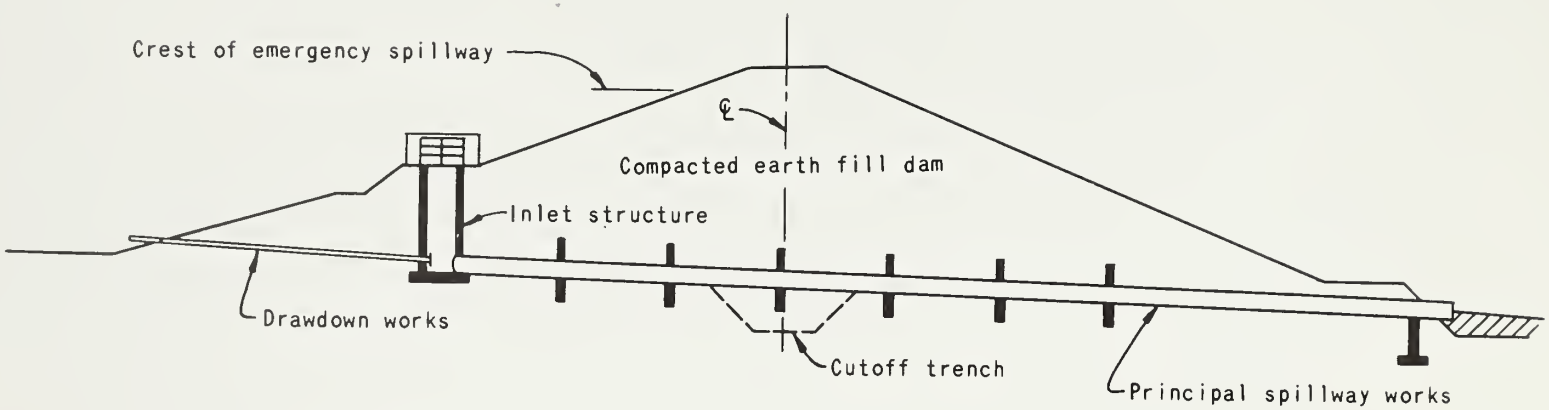
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TYPICAL EARTH DAM WITH PIPE DROP INLET



CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY

NOTES:

1. FOR INDIVIDUAL STRUCTURE DATA SEE TABLE 3.
2. EMBANKMENT AND FOUNDATION DESIGN FEATURES NOT SHOWN.

U.S.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE.

WET WALNUT CREEK WATERSHED NO.3

NESS COUNTY, KANSAS

STRUCTURE NO.34

PUBLIC RECREATION DEVELOPMENT.

SCALE 300 100 300 600 900 1200 FEET
200 0

POPULATION CENTERS AND HIGHWAYS
WITHIN 50 MILE RADIUS

SCALE 10 5 0 10 20 30 40 MILES

LEGEND

1. BOAT RAMP
2. DRINKING WATER WELL
3. PARKING AREA & ROAD
4. PICNIC TABLE
5. PICNIC TABLE WITH SUNSHADE
6. TOILET

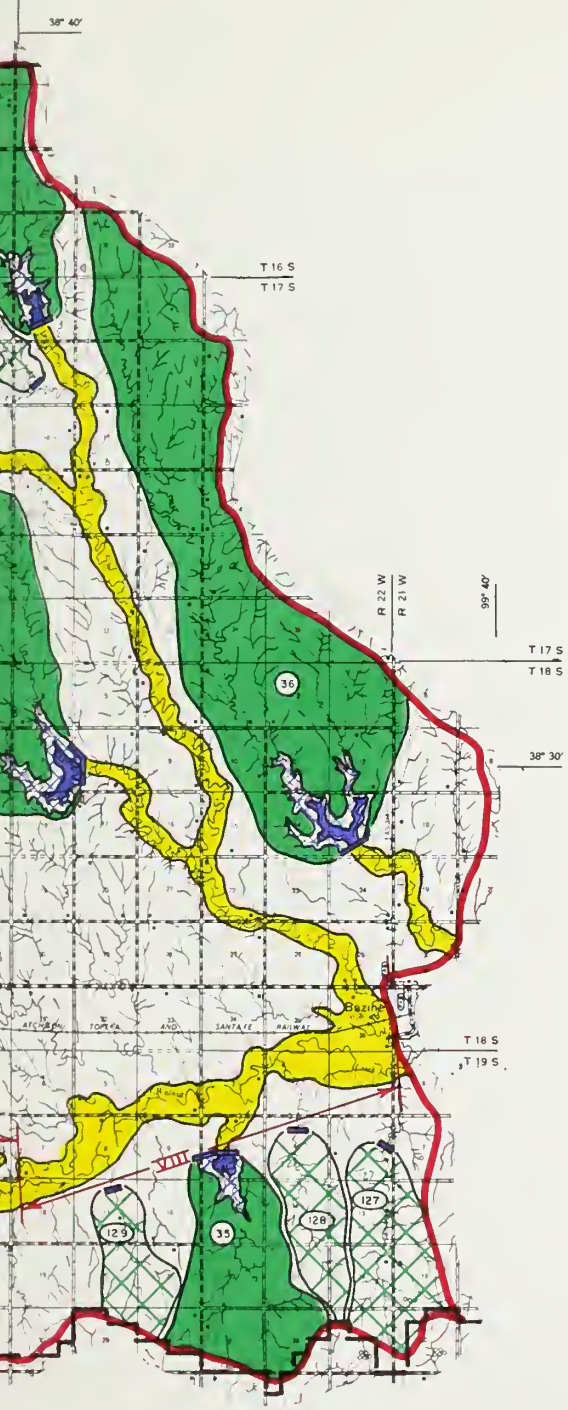
PROJECT MAP

SOIL CONSERVATION SERVICE

NO. (3) WET WALNUT CREEK WATERSHED

NESS COUNTY

KANSAS



LEGEND

FLOODWATER RETARDING OR MULTIPLE PURPOSE STRUCTURE

SEDIMENT STORAGE POOL

MUTIPURPOSE STORAGE POOL

FLOODWATER DETENTION POOL

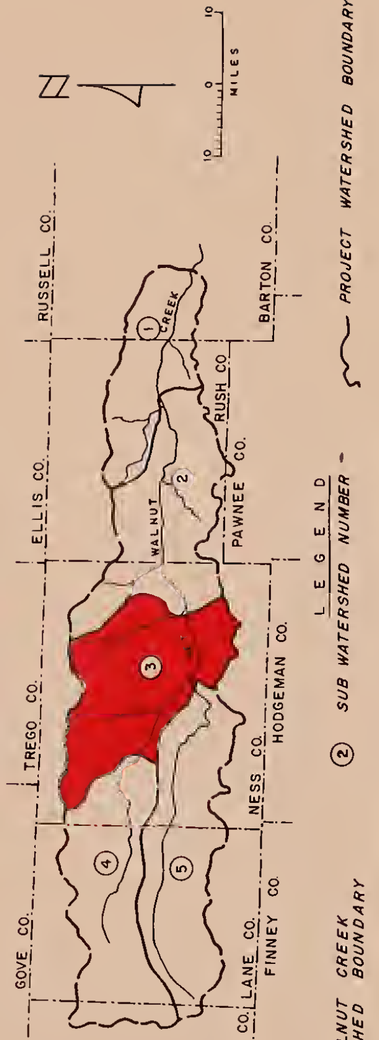
AREA BENEFITED

DRAINAGE AREA CONTROLLED BY R. E. A. P. STRUCTURE

(2) P. L. 566 STRUCTURE NUMBER

(202) R. E. A. P. STRUCTURE NUMBER

WATERSHED PROJECTS LOCATION
WET WALNUT CREEK



LEGEND

② SUB WATERSHED NUMBER - PROJECT WATERSHED BOUNDARY

WET WALNUT CREEK WATERSHED BOUNDARY

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PROJECT MAP

SUBWATERSHED NO. ③ WET WALNUT CREEK WATERSHED

NESS COUNTY

KANSAS

DRAINAGE AREA IN SQUARE MILES

㉞	4.90	⑫⑥	3.79
㉟	5.40	⑫⑦	4.13
㊱	18.80	⑫⑧	2.52
㊲	10.10	⑫⑨	2.14
㊳	18.60	⑬⑩	1.41
㊴	16.80	⑬①	6.12
㊵	5.60	⑬②	4.77
㊶	18.47	⑬③	3.67
㊷	10.93	⑬④	5.84
㊸	9.60		
㊹	14.60		
㊺	43.80		

LEGEND

- LEGAL WATERSHED BOUNDARY
- NATURAL WATERSHED BOUNDARY
- DRAINAGE AREA CONTROLLED BY P.L. 566 STRUCTURE
- II EVALUATION REACH
- FLOODWATER RETARDING OR MULTIPLE PURPOSE STRUCTURE
- SEDIMENT STORAGE POOL
- MUTIPURPOSE STORAGE POOL
- FLOODWATER DETENTION POOL
- AREA BENEFITED
- DRAINAGE AREA CONTROLLED BY R.E.A.P. STRUCTURE
- (2) P.L. 566 STRUCTURE NUMBER
- (202) R.E.A.P. STRUCTURE NUMBER

SOURCE:
INFORMATION FURNISHED
BY FIELD TECHNICIANS,
EVANS - BIERLY - HUTCHISON ENGINEERS